THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK APRIL, 1913

Hot Blast Heating for an Ice Skating Rink

UNIQUE CONDITIONS MET IN THE EQUIPMENT OF THE WINNIPEG HORSE SHOW AMPHITHEATRE.

A heating plant of unusual interest has lately been installed in the Winnipeg Horse Show Amphitheatre, from the design and under the supervision of Roberts & Firth, mechanical engineers, of that city. The Amphitheatre is the largest heated building of its kind in this or any other climate of equal severity.

The building was erected by the Winnipeg Horse Show Association in 1909, for the purpose of holding its annual show during the summer season, and for use as a skating rink in the winter. The amphitheatre consists of a main building, 130 ft. x 280 ft., containing the arena, with tiers of seats all around, having a seating capacity of about 5,000, and a total cubical contents of about 756,000 cu. ft.

It is a frame building with arched roof, fitted with skylights, and has large ventilators, 10 ft. x 12 ft., in both ends of the building near the roof.

At the south end of the building is the club house, 38 ft. x 130 ft., consisting of three stories and basement, in which are the offices, waiting, refreshment rooms, etc. This portion is heated by means of direct steam radiation supplied from two cast-iron boilers in the basement. At the east side is the riding academy, 62 ft. x 130 ft., with a cubical contents of 132,000 cu. ft., communicating with the main building by means of large doors.

REQUIREMENTS INCLUDED HEATING OF ICE SKATING RINK.

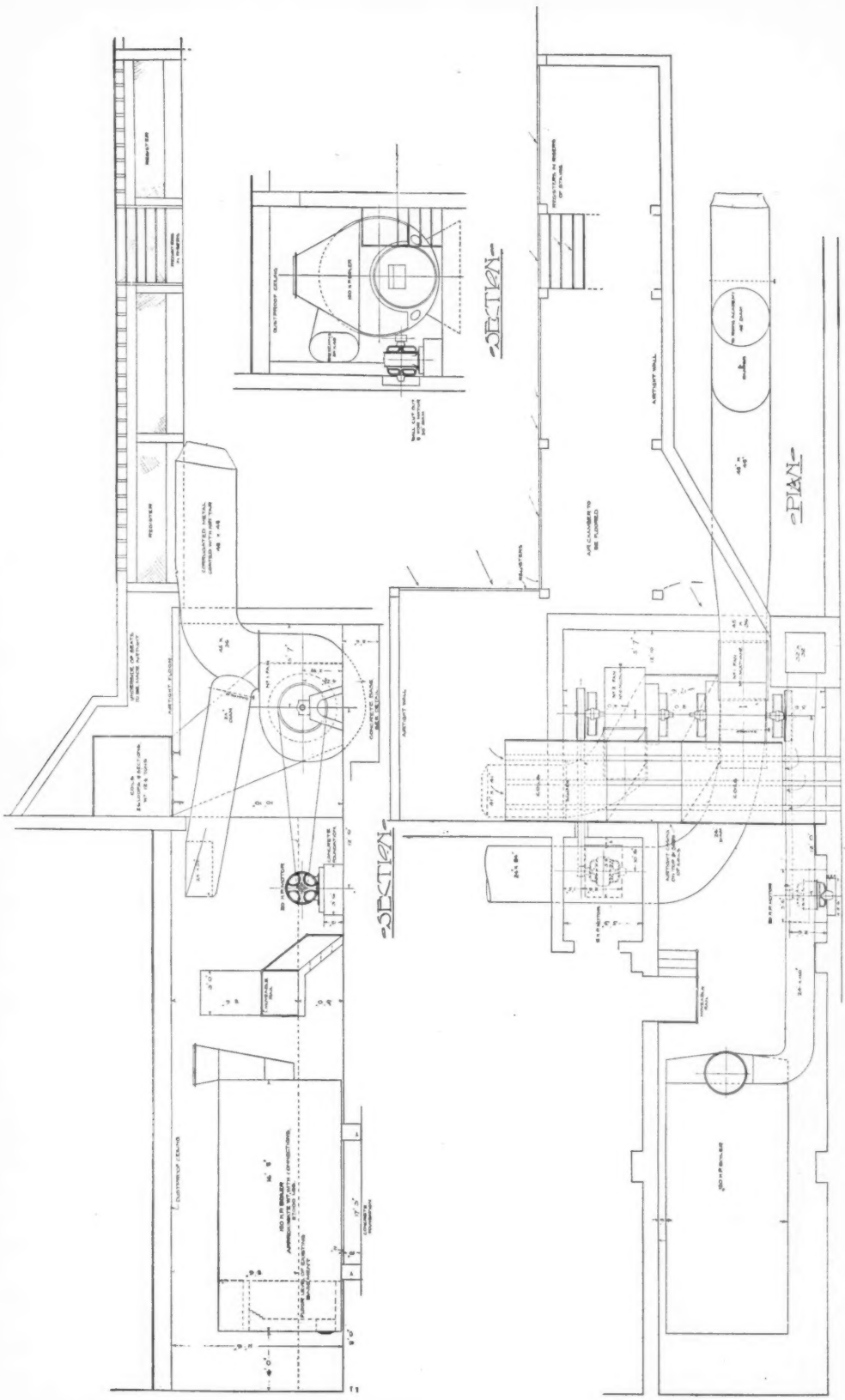
It was desired to warm the air in the main building sufficiently to make it comfortable for spectators in cold weather, without impairing the ice, and also to render it possible to utilize the building for concerts, or other performances, during the Spring and Fall, when the skating season was over, and when the weather was still too cold to use the building without heat. There have been occasions when opportunities of renting the building for such purposes have been lost, owing to the building having no heating apparatus.

The specifications therefore called for a temperature of 40° F. inside the main building, with the outside temperature at —40°.

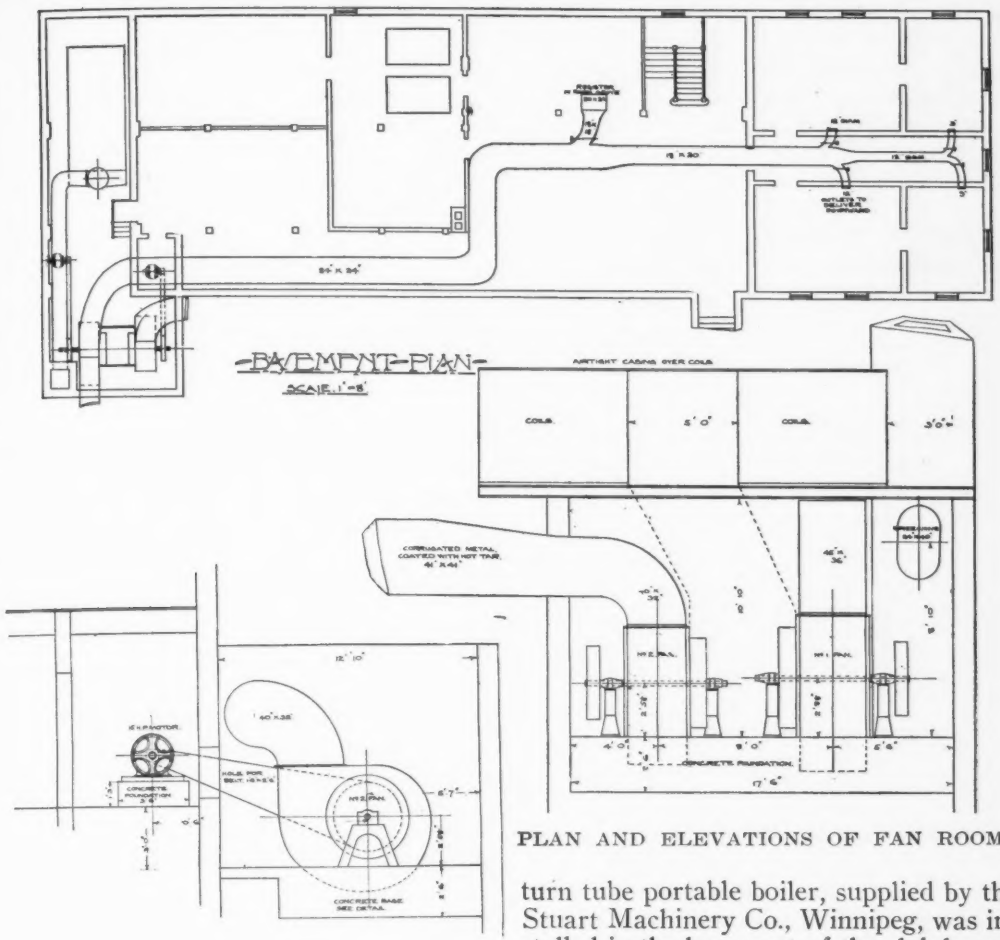
In deciding on the best method of warming the building, the following points had to be taken into consideration:

(1) The heat was required to be distributed round the sides and ends of the building where the seats are placed, with as little heat as possible being conveyed over the surface of the ice.

(2) Provision had to be made that the warm air should not be allowed to rise to the roof, as the inner surface of the roof becomes thickly coated with frost during the cold weather from the vapor



PLAN AND ELEVATION OF FAN ROOM, WINNIPEG HORSE SHOW AMPHITHEATRE, SHOWING AIR INTAKES.



PLAN AND ELEVATIONS OF FAN ROOM.

rising and condensing when flooding the rink.

(3) The riding academy required to be warmed in order to enable the sawdust and tanbark floor to be damped, for the purpose of keeping down dust, without freezing, at times when the rink was not being used; the rink being heated whilst the riding academy is not in use.

(4) It was desired to supplement the heat already in the club building by heating additional rooms, not already heated.

(5) It was desired to provide means for cooling the air in the building during the Summer.

HOT BLAST SYSTEM SELECTED.

After considering various alternative schemes, it was decided to warm the building by circulation of air drawn through steam coils by electrically-driven fans. For this purpose a 150-H.P. return tube portable boiler, supplied by the Stuart Machinery Co., Winnipeg, was installed in the basement of the club house, and was connected to Vento cast-iron coils, 60-in. high, arranged in two stacks of eight groups of 13 sections each, having a total heating surface of 3,328 sq. ft.

The coils are enclosed in a steel casing, open at the two ends for the admission of the returning air from the building, and connected in the centre to the inlets of the fans, which stand below. The coils are placed with their lower ends at a height of 4 ft. above the level of the water line of the boiler, so that the condensation will return to the boiler by gravity, without the use of pumps.

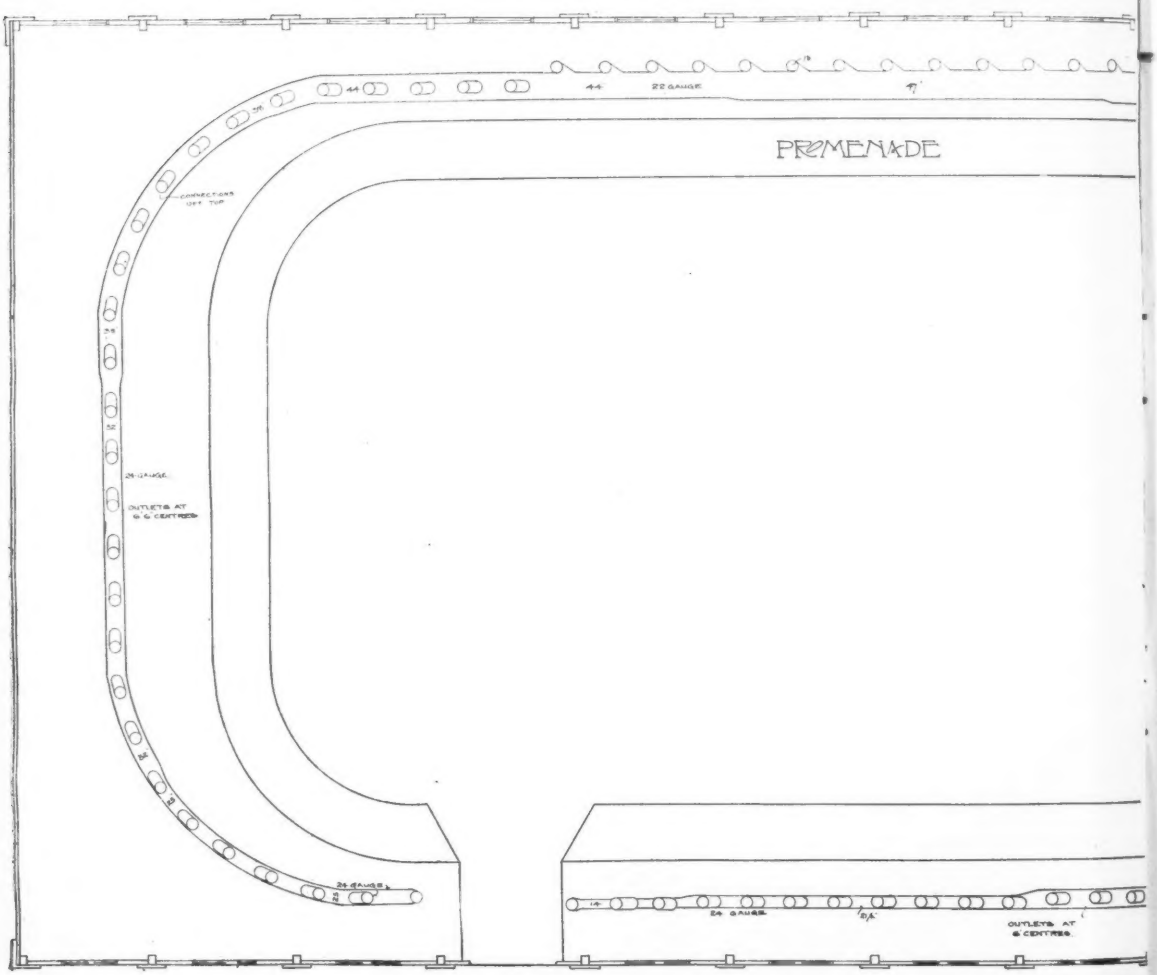
The main steam pipe supplying the coils is 7 in., with 2½-in. branches, separately valved to each of the 16 sections. A 1½-in. pipe, connected to the blow-off pipe, returns the condensation to the boiler, and the blow-off pipe is also connected to a blow-off tank, with an overflow outlet to the sewer, for the

purpose of draining the system, valves being provided on the different connections. On the return from each group of coils are placed two automatic air valves and also a petcock, to insure the thorough venting and draining of the coils when steam is shut off.

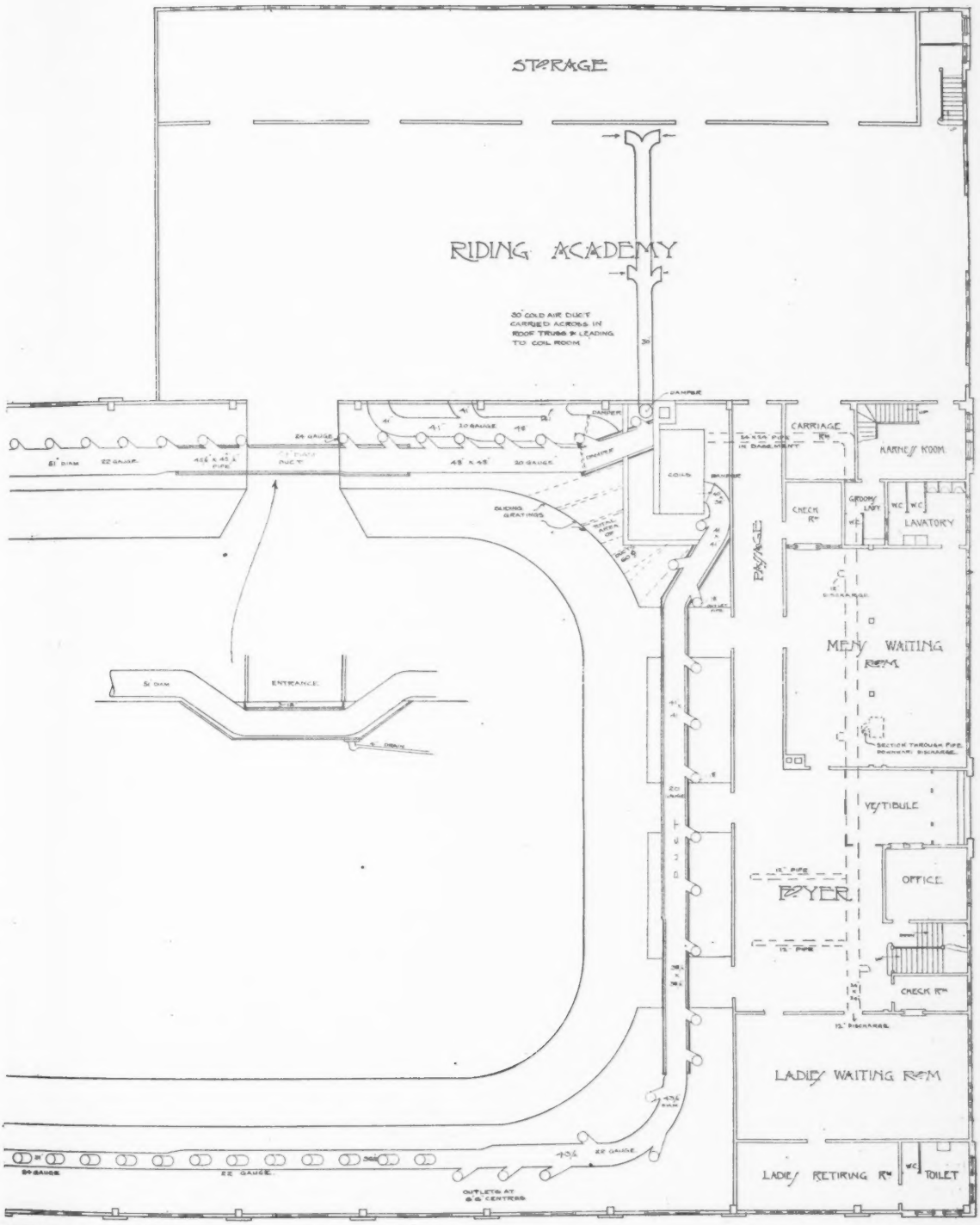
In addition to the 7-in. pipe to the Vento coils, the boiler is connected by a 4-in. steam pipe to the original heating system in the clubhouse, each pipe being valved, so that the whole of the heating may be done by the new boiler, or the two original boilers may be used as auxiliaries, if desired. An 8-in. pipe from the boiler supplies steam to these two pipes.

The boiler is lagged with magnesia blocks and ½ in. of asbestos cement, the whole being covered with canvas. The steam pipes are covered with air cell asbestos pipe covering, and the breeching is covered similarly to the boiler, but with 1 in. air space between the breeching and covering. The smoke stack is of brick, 32 in. square inside, to a height of 50 ft. above the grates, lined with firebrick, and surmounted by a steel stack 36 in. diameter by 52 ft. high, giving a total height of 102 ft. above the grates. The combustion is such that when burning bituminous slack coal and running the plant to its full capacity, there is little or no smoke to be seen coming from the stack.

The air is circulated by means of two Sturtevant ⅞-housed Multivane fans, the larger one having a wheel 52½ in. diameter, designed to run at a speed of 289 R.P.M., and the smaller one having a wheel 46½ in. diameter, designed to run at a speed of 317 R.P.M., belt-driv-



GROUND PLAN OF ARENA, WINNIPEG HORSE SHOW AMPH

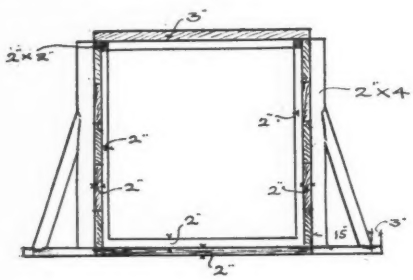


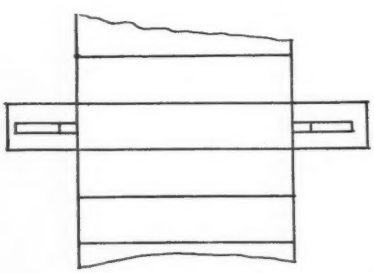
THEATRE, SHOWING AIR DISTRIBUTION UNDER SEATS.

en, respectively, by 20-H.P. and 15-H.P. variable speed Canadian General Electric Co.'s A. C. electric motors. The object of the variable speed motors is to enable the discharge of air to be varied to suit varying conditions of weather.

ARRANGEMENT OF AIR DUCTS.

This arrangement is sufficient to provide, when the fans are running at their full speeds, four changes of air per hour in the main building. The fans, coils, and motors are placed in an extension of the basement underneath the seats at the southeast corner of the main building. The warm air is distributed through the main building by means of galvanized-iron ducts concealed under the tiers of seats. The duct from the larger fan is 48 in. square near the fan, and extends along the east side and the

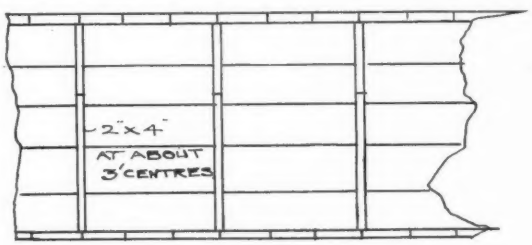




north end, being gradually tapered down to 25 in. diameter at the end near the northwest corner of the building. The duct from the smaller fan is 41 in. square near the fan, and extending along the south end and west side of the building, reduces down to 14 in. at the end, which is close to, but not connected with, the end of the larger duct. From these ducts, small branches are taken, terminating in outlets under the seats. The 96 outlets along the two sides and the south end have an area of 180 sq. in., and 50 along the north end, 160 sq. in. each. The air is discharged from these outlets at a temperature of about 100° F., with a velocity of about 300 ft. per min., and the ducts are so designed that there is practically the same rate of discharge from each of the outlets throughout the building.

AIR SUPPLY FOR RIDING ACADEMY.

For the purpose of warming the riding academy, the duct from the larger fan is fitted with a 48-in. square branch running up to a height of about 20 ft. above the ground, and branching into two 41-in. diameter outlets set at 45°, discharging horizontally above the heads of the horses. A damper is provided so that the air may be discharged either into the main building, or into the riding academy, as desired. The height of the discharge in the riding academy is neces-



DETAILS OF BOX FOR AIR DUCTS.

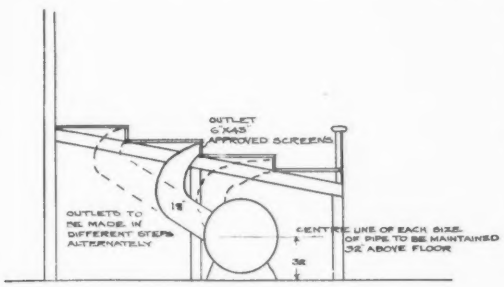
sary to prevent an unpleasant flow of air to horses and riders. A separate duct is also provided from the larger fan, 24 in. in diameter, for the purpose of warming some of the rooms in the basement of the club house, which are not steam heated, and for supplying warm air to the ticket office at the main entrance on the ground floor to prevent draft of cold air, when the outside doors are open to admit the public.

UNUSUAL CONDITIONS ATTENDING OPERATION OF PLANT.

As an indication of the requirements in the heating of this building, it may be noted that during cold weather the temperature inside the building has been recorded as low as —21° F. With the present heating system it is possible to maintain, in the coldest weather, a temperature as far above freezing as is permissible without damaging the ice.

The effect of the method adopted for distributing and circulating the air is such that the temperature of only the air in the lower part of the building is affected, to a height of about 20 ft. That of the upper stratum of air next the roof is left undisturbed.

An illustration of what the effect would be, if the heat were allowed to circulate to the roof, was afforded on one occasion when, during a hockey match, the riding academy was warmed to a higher temperature than the rink, and when the doors were opened between the rink and the riding academy to permit the quicker exit of the spec-



SECTION OF ARENA SEATS SHOWING AIR OUTLETS.

tators at the close of the match, there was a sudden rush of warm air into the rink which rose to the roof and caused an immediate precipitation over the entire surface of the rink.

TEMPERATURE RAISED WITHOUT USE OF STEAM.

Another illustration of the benefit afforded by the circulation of air through the building was given on another occasion, when the outside temperature was zero, and the temperature inside the rink was 10°, with about 500 people skating. Air was circulated by the fans, but with no steam turned on in the coils, and in one hour the temperature had risen to 24°, a rise of 14° F., without the use of any steam.

TEMPERATURE TESTS.

The following figures will give some idea of the results that have been so far obtained in warming the building. Observations were made of the temperatures at three different points in the building, at a height of about 20 ft. above the level of the ice. On the occasion of the ice carnival, when the outside temperature was —14° F., it was found that when the full heat was turned on the rise in temperature was so rapid that, after running for 45 minutes, it was considered advisable to shut off a portion of the steam coils, lest the ice should be affected. During the first period, when the full heat was on, the temperature inside the rink rose from 10° to 19°, or about 1° for every 4½ minutes. During the remaining hour and a quarter that the fans were running the temperature rose to 28°, or about 1° every ten minutes.

On one occasion, during a hockey match, when the outside temperature was—18°, the full heat was kept on, and in one hour and five minutes the temperature inside the building was raised from 5° to 18°, or 1° every five minutes.

The heating of the riding academy has proved equally successful. A test was made when the temperature outside was —25°, by first sprinkling the floor with water, which at once froze the surface hard. Heat was then turned on, and in less than an hour the temperature inside was above freezing and in 2½ hours rose to 60°.

It is customary to flood the ice immediately before the commencement of a hockey match, after the rink has been in use for general skating, and the experiment was tried of flooding after the heat had been turned on. It was found, however, that under these circumstances the water would lie on the surface without freezing, although when it is once frozen it remains good with a temperature a few feet above the ice as high as 38°. It is, therefore, necessary to have the ice flooded and frozen before any heat is turned into the building.

The accompanying plans show the general methods followed, although the details have been somewhat modified, due to the fact that since the drawings were made the seating has been rearranged, doubling the capacity.

The Charette Kirk Co., Ltd., of St. Boniface, Man., were the contractors for the installation of the heating apparatus, and during the few weeks that it has been in operation, it has shown results which amply justify the expenditure on it.

Successful Rules for Heating Greenhouses

Some interesting statistics regarding greenhouse construction and equipment, as well as some successful rules for calculating the radiation requirements, were given in a paper by Prof. W. J. Wright, read at the recent annual convention of the Vegetable Growers' Association, in Rochester, N. Y. Prof. Wright communicated with 100 growers on subjects ranging from cost of construction to pitch of roof. One of the questions asked was the kind of heat preferred by the owners. 86% of those having 20,000 sq. ft. or more under glass, preferred steam heat. The chief reasons stated being "better control," "cheaper maintenance," and "less shade from pipes." Six per cent. preferred a combination of hot water and steam, using the steam as a help in extreme weather and for use in soil sterilization. The remaining 8% preferred hot water, stating as their reasons "steadier heat," "plants grow better," "pipes do not rust out during the summer as with steam," and "cheaper to operate when but little heat is required."

Of those having less than 20,000 sq. ft., 74% preferred hot water, giving in addition to the reasons named above "less labor to fire, especially at night," and "needs no night firemen." Of those using hot water, 21% were using some form of mercury pressure system or "generator" and 14% more believed them desirable. The reasons given were "needs less piping" and "circulation better."

The average amount of soft coal a season for each 1,000 sq. ft. of area covered (all kinds of heat) was 11.6 tons and the average price was $2.33 per ton, delivered.

HEATING CALCULATIONS.

The calculations for greenhouse heating are based on certain simple fundamental facts which may be stated briefly as follows:

A square foot of glass will give off, under ordinary greenhouse conditions in winter weather, approximately 1 B. T. U. of heat for each degree difference in temperature between the temperature of the air inside the greenhouse and that outside. In hot water heating, the heating coils will give off 2 B. T. U. a square foot for each degree difference in temperature between that of the coils and that of the surrounding air.

Suppose, for example, that a house contains 1,000 sq. ft. of glass and that it is desired to keep it at a temperature of 60° F. and that the lowest temperature that may be expected is 10° below zero. The number of B. T. U. given off by such a house each hour would be 60° —(—10°)x1x1,000, or 70,000 B. T. U. In hot water heating the average temperature of the heating pipes may be assumed to be 160° and if the temperature to be maintained in the house is 60° the difference will be 100°. Since each square foot of pipe will radiate 2 B. T. U. each hour for each degree difference in temperature, under these conditions 1 sq. ft. of radiating surface will give off about 200 B. T. U.

Dividing the 70,000 B T. U. given off by the glass surface by 200 will give us 350 or the number of square feet of radiation necessary.

These principles may be embodied in the following formula: $\frac{(T-t)\times G}{(160-T)2}=R.$

In this formula R=the number of square feet of radiation, T the temperature to be maintained inside the house, t the lowest outside temperature to be expected, and G the number of square feet of glass and equivalent glass.

Glass will give off about six times as much heat as a good, substantial, well-built wall. To find the amount of heat radiated by any house, therefore, find the number of square feet of exposed glass and add to it 1-6 of the exposed wall surface.

Take, for example, a house where the total glass surface amounts to 4,205 sq. ft. and the exposed wall surface is 480 sq. ft., which divided by six gives an equivalent of 80 sq. ft. of glass or a total of 4,285 sq. ft. of glass and equivalent glass. If we substitute these values in our formula it becomes as follows:

$$\frac{60-(-10\times4{,}285}{(160-60)2}=1450 \text{ sq. ft.,}$$

which is the number of square feet of radiation necessary to heat this house to 60° F. when the weather outside is 10° below zero.

To find the number of linear feet of pipe necessary to supply the required radiation, it is necessary only to find the amount of radiating surface in one linear foot of the size of pipe it is desired to use. For example, one linear foot of 1½-in. pipe furnishes about 0.5 sq. ft. of radiating surface. Dividing 1,450 by 0.5 gives us 2,900 linear feet of 1½-in. pipes necessary to heat the house, and if the house is 90 ft. long, it would be necessary to use 32 lengths of 1½-in. pipe. Since, however, these pipes must be fed by flow pipes which carry the hot water, and since these flow pipes radiate heat, the number of coils may be somewhat reduced. But to allow for a margin of safety it would probably be well to use about thirty 1½-in. hot water heating pipes. Pipes this size are large enough for coils 150 ft. or less in length.

AMOUNT OF RADIATING SURFACE IN A LINEAR FOOT OF WROUGHT PIPE OF VARIOUS SIZES.

Size of pipe, inches, diameter.	Amount of surface per lineal foot.
1	0.344
1¼	0.434
1½	0.497
2	0.621
2½	0.752
3	0.916
3½	1.044

Steam pipes are hotter than hot water pipes as ordinarily used, and therefore houses heated with steam require less radiating surface than those heated with hot water. Steam is usually carried at about 2 lbs. pressure and at that pressure has a temperature of about 218° F. In condensing to water this steam gives up its latent heat (approximately 1,000 B. T. U. a pound). One square foot of radiating surface will condense a little more than ¼ of a pound of steam each hour, assuming that the conditions are the same as above; namely, that the temperature in the house is to be maintained at 60° F. with an outside temperature of—10°.

In other words, 1 sq. ft. of steam radiating surface will give off about 260 B. T. U. per hour. We then have

$$\frac{60-(-10)\times4{,}285}{260}=1153$$

sq. ft. of steam radiation required, or 2,306 linear feet of 1½-in. pipe, or 25 lengths of 1½-in. pipe extending across the length of the house, which would be equal to about 30 lengths of 1¼-in. pipe, which is the size generally used in steam heating for coils 150 ft. or less in length. In practice much less steam radiation is usually provided, with the understanding that a higher pressure and consequently a higher temperature will be maintained in severe weather.

STEAM VERSUS HOT WATER.

While our inquiries showed that 86% of the larger growers preferred steam for heating, it is true that many of the more modern large ranges are being equipped with hot water. This is done for the reason that crops are supposed to grow better under hot water than under steam heat. It is probably true that plants do not do as well in the superheated air near a hot steam pipe as they do near an old-fashioned 3½-in. hot water pipe at 150° F.

On the other hand, the modern tendency is to place all or part of the pipes overhead and far enough away from the plants so that the heat is evenly distributed. It is also true that in many of these hot water systems which are being installed a "pressure" system is being used which makes possible the raising of the temperature of the water to 240°, which is equal to 10 lbs. of steam. This is a higher pressure and consequently a higher temperature than is usually carried by the ordinary steam heating plant. During the spring and fall the hot water has some advantage because it can be kept at a low temperature, while steam must always be at 212° or more.

GENERATOR OR PRESSURE SYSTEM.

The so-called generators or pressure systems depend for their action upon a column of mercury which must be forced up out of the way before the heated water can find its way to the ex-

pansion tank. They usually exert about 10 lbs. pressure. These generators are automatic in their action and are claimed by the manufacturers to produce a more rapid flow of water in the heating pipes. The same effect may be secured by elevating the expansion tank or by having a closed expansion tank fitted with a safety valve set at a certain pressure. In long houses it is necessary to supplement gravity circulation by pumping. This may be also done under pressure.

WROUGHT OR CAST BOILERS.

The cast-iron boiler has a size limit above which it is impracticable to go. Moreover, there is evidence that with its thick water ways it is less economical of fuel than are the thinner shelled wrought-iron boilers. On the other hand, cast-iron boilers do not rust as badly as wrought-iron ones when not in use and have no flues to be burned out by the sulphurous gases and to cause annoyance and expense in replacing. But they do sometimes crack and they have a disgusting way of doing it at the most inopportune moment.

When fuel is cheap and abundant, and especially in a small range where the heating system is likely to be neglected during the summer, cast-iron boilers usually give the best satisfaction. Where coal is expensive, and especially if it is of good grade and free from sulphur, wrought-iron boilers are probably best. No matter what kind of heat or kind of boiler is used, it is always best to use two small boilers, both of which may be connected with the main system, than one large one. One of the small boilers will take care of the house during the spring and fall more economically than a large one and in case one goes wrong during the winter weather the other may be "forced" for a few days and save the crop, when if one large boiler was depended on, the crop would be ruined.

Regulating the Air Conditions in a Glove Steaming Room

SOLUTION OF A DIFFICULT PROBLEM IN FACTORY OF JULIUS KAYSER & CO., BROOKLYN, N. Y.

All silk gloves, before being boxed for shipment, are dried by some method to give them a finished lustre and shape. There are three processes in use to-day to accomplish this result; one is exhaust steam drying on metal forms; the second is electrical drying on electrical dryer forms; and the third method is a steaming process, in which the gloves are held in position manually and passed through steam jets.

The last-named method is the one used by Kayser & Co. in some of their factories, with eminently satisfactory results, so far as the finish is concerned, but with disastrous results to the girls who have to handle the gloves, due to the moisture, the condensation, the oppressiveness and the effect of the moisture on their bodies and clothes after leaving the room.

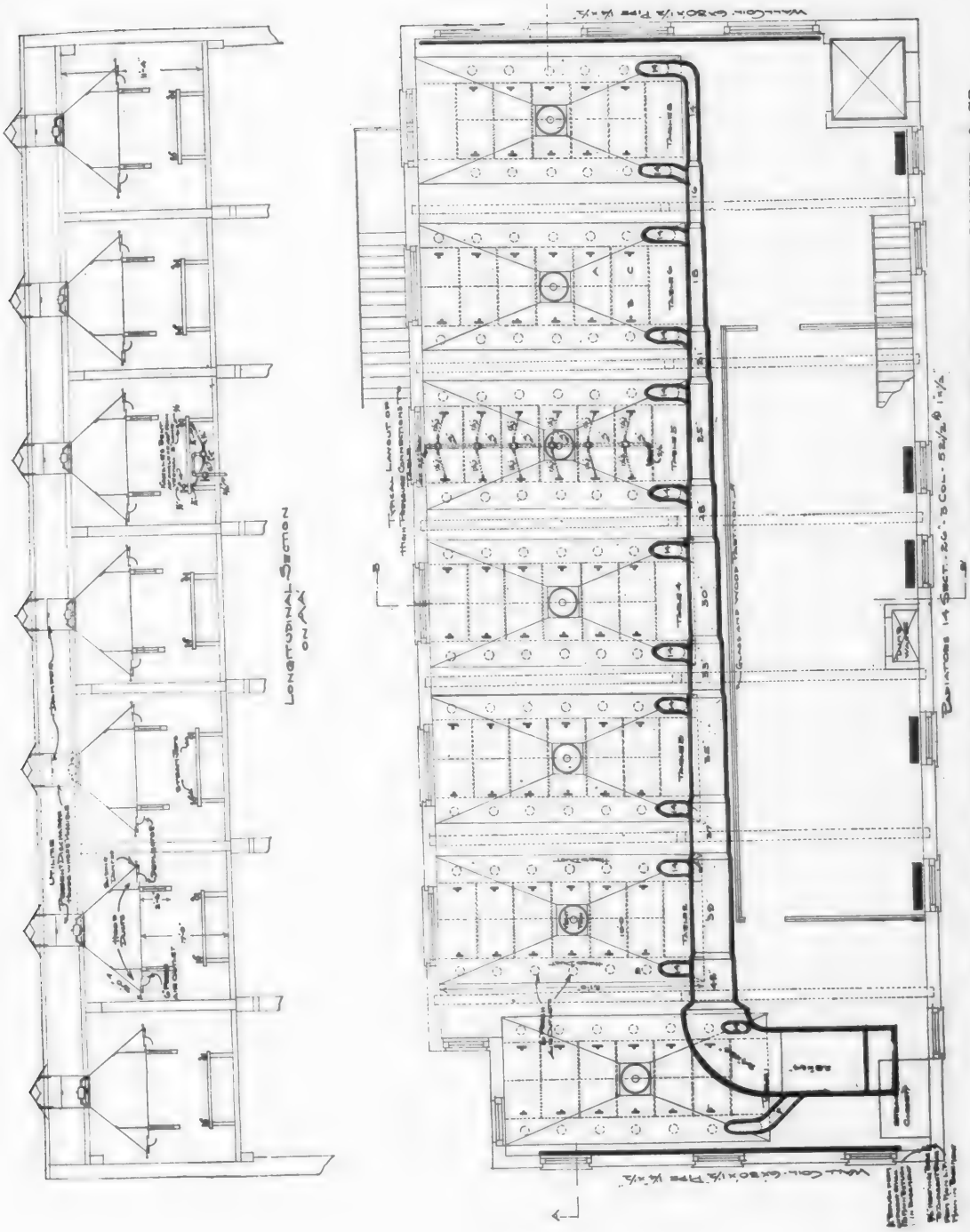
As far as the finished glove product is concerned, the process was satisfactory, except when the condensed steam dropped on the fabric or when too great moisture in the steam prevented the proper finish.

Many methods of overcoming all of these difficulties, both to the goods and to the operators, were tried, and the illustrations here shown, with certain modifications made since that time, have overcome practically all of these objections.

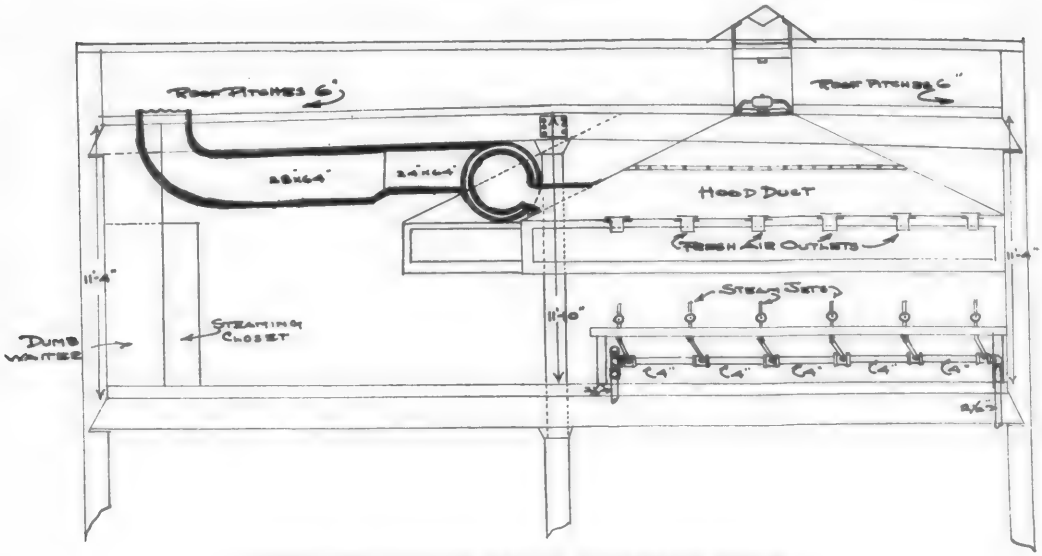
THE STEAM PROCESS.

Directly from the boiler header a high pressure steam line carrying steam at 130 lbs. pressure is carried up to the floor underneath the steaming department. At this point the steam is taken through a Cochrane receiver separator and then through a by-passed superheater, which is only used when the moisture in the air is excessive or when the forcing of the boiler carries over more water than the separator will take out.

From this point the main is carried



ARRANGEMENTS FOR VENTILATING GLOVE STEAMING ROOM, PLANT OF JULIUS KAYSER & CO.



CROSS SECTION ON B B OF STEAMING ROOM.

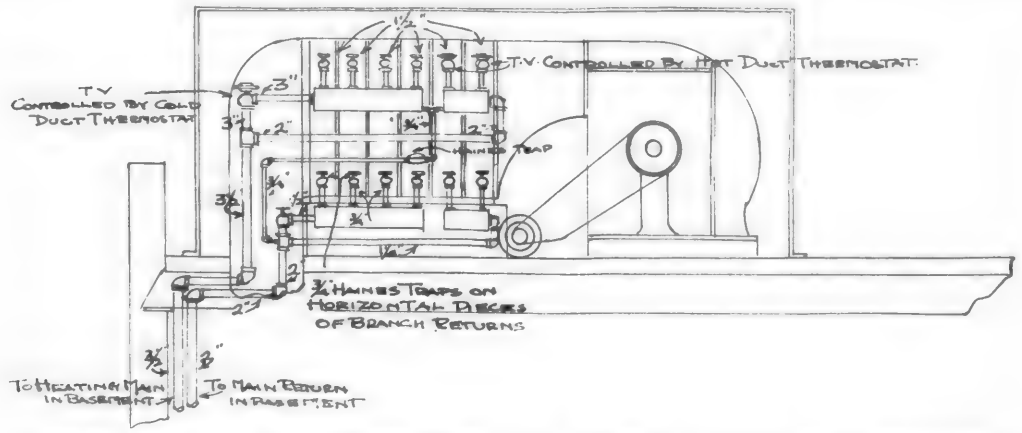
into 4-in. headers under each steaming table, and from this header are taken 14 connections to 14 nozzles. Each header is dripped at both ends and the connections to the nozzles are all taken off on 45° angles, to prevent any lodgment of moisture in the connections. In the top of the connections, below the table itself, perforated ½ in. brass pipes are taken well down into the connection itself, forming a sort of additional separator at each nozzle. The top of the nozzles are capped with brass caps perforated with from five to seven 1/64 in. holes, and each nozzle is controlled by an extra heavy bronze specially-packed globe valve, these valves having been made specially for this work, due to the fact that they are opened and closed several hundred times a day.

All of the drips from the high pressure headers are carried back in separate lines to a large steel drip header, which is trapped by means of Cranetilt traps, located in the pump room, these traps being by-passed in multiple and so arranged that in case one does not work the other is immediately put in service. All of the high-pressure work is insulated as thoroughly as could possibly be done.

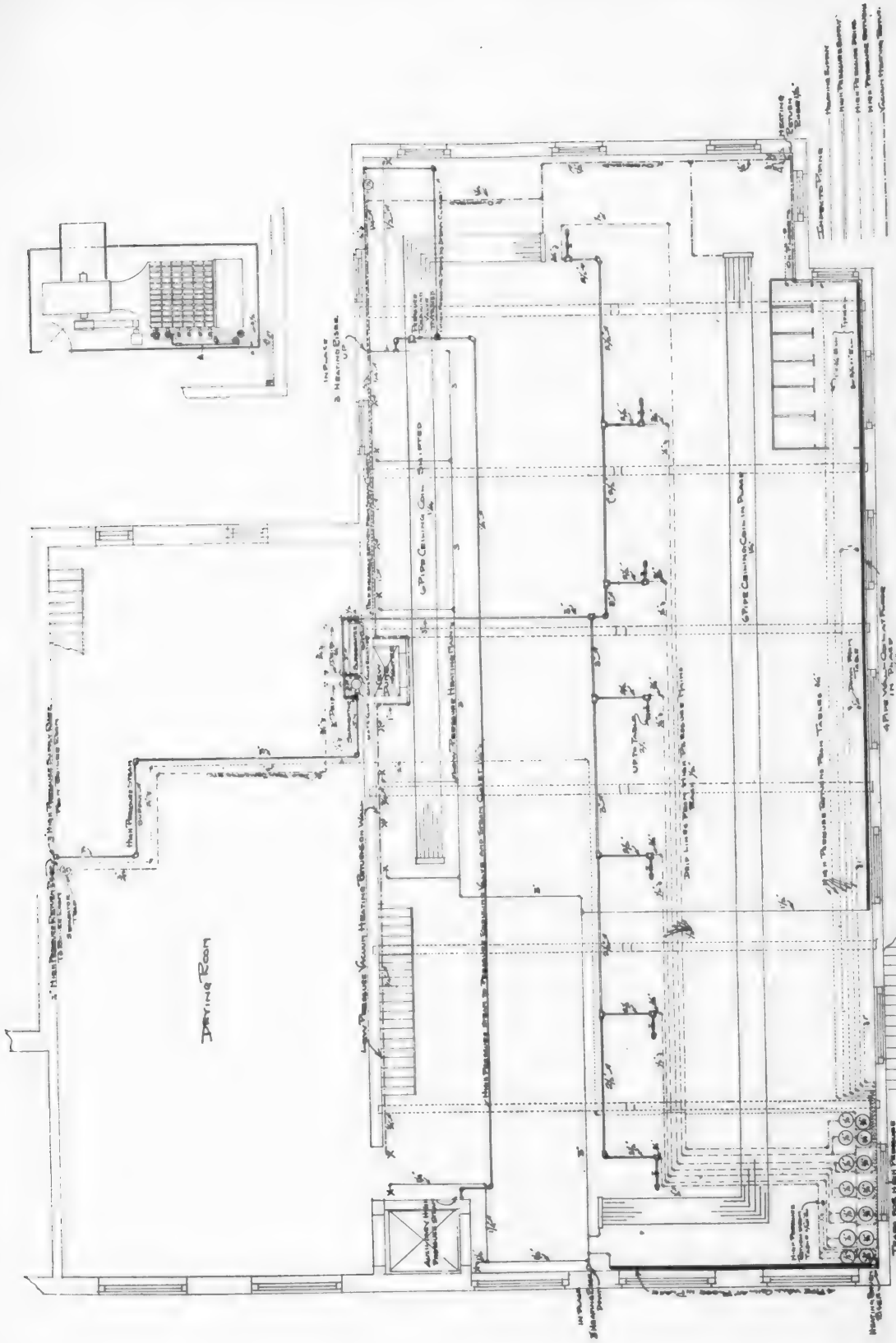
All fittings beyond the superheater are semi-steel, for 100° superheat, and all valves are designed for 100° superheat.

CHANGE OF AIR EVERY THREE MINUTES.

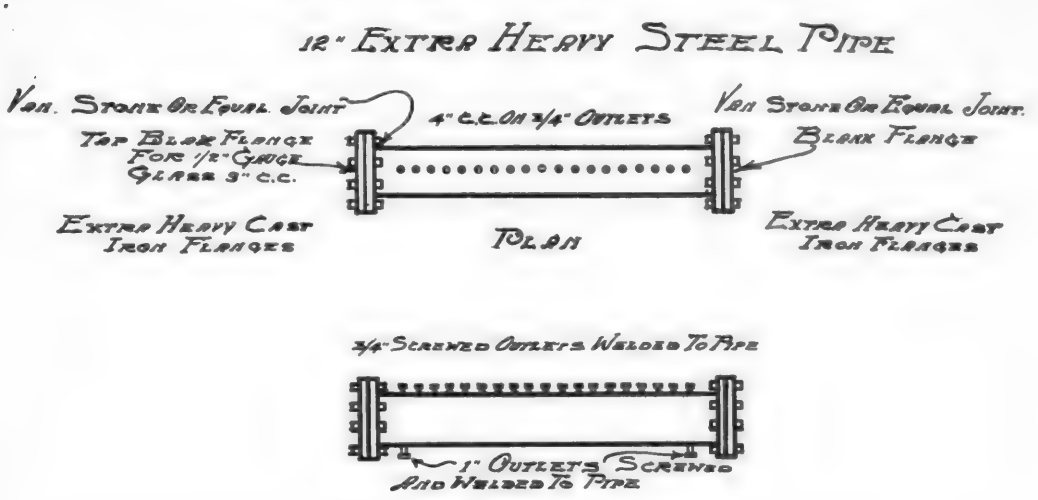
The ventilation of the room is accom-


T.V. CONTROLLED BY HOT DUCT THERMOSTAT
T.V. CONTROLLED BY COLD DUCT THERMOSTAT
HAINES TRAP
¾" HAINES TRAPS ON HORIZONTAL DECKS OF BRANCH RETURNS
TO HEATING MAIN IN BASEMENT
TO MAIN RETURN IN BASEMENT

STEAM AND RETURN CONNECTIONS FOR INDIRECT STACK FOR STEAMING ROOM, PLANT OF JULIUS KAYSER & CO.



PIPING ON THIRD STORY CEILING, GLOVE STEAMING PLANT OF JULIUS KAYSER & CO.

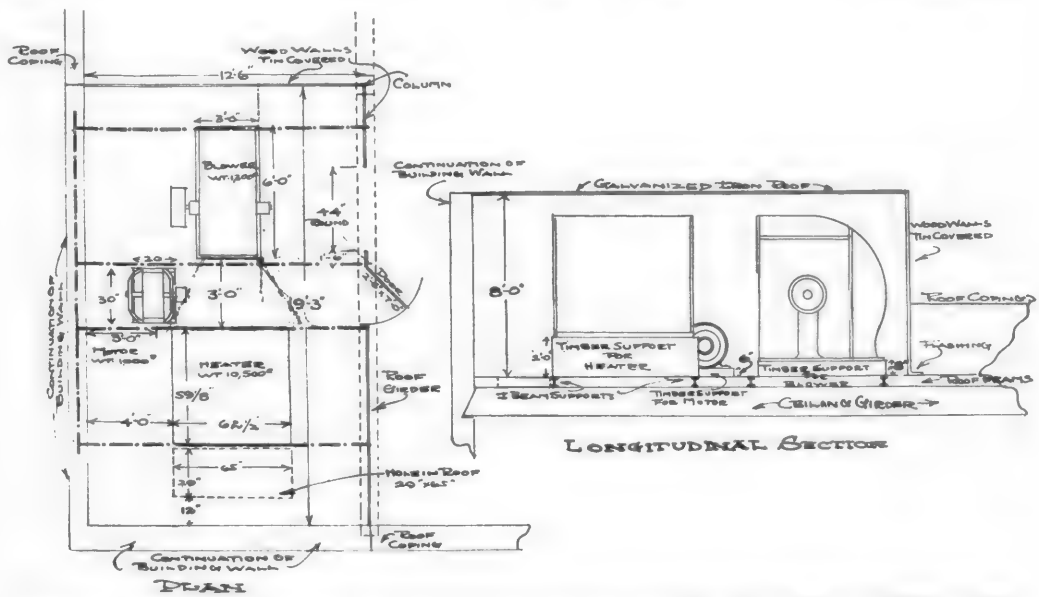

12" Extra Heavy Steel Pipe
Van. Stone Or Equal Joint
4" C.C. On 3/4" Outlets
Van Stone Or Equal Joint.
Top Blank Flange For 1/2" Gauge Glass 9" C.C.
Blank Flange
Extra Heavy Cast Iron Flanges
Plan
Extra Heavy Cast Iron Flanges
3/4" Screwed Outlets Welded To Pipe
1" Outlets Screwed And Welded To Pipe
Elevation

DRIP HEADER FOR STEAMING ROOM, USED IN PLACE OF SEPARATE TRAPS.

plished by means of a Conoidal fan, having capacity to change the air in the entire room every three minutes. This fan is run by means of a 7½ H.P. belted motor, and the air is strained through a double set of filter screens and then forced through a 6-group Vento stack. The size of the stack was determined by experiments made to find out the balance between the temperature of the incoming air to prevent its contact with the steam, condensing the steam.

It was found that under ordinary conditions 120° would accomplish this result, whereas any temperature lower than this caused the steam rising from the jets to condense. This air is brought in and discharged through special ducts arranged in the hoods over the tables, to keep the hoods themselves up to the desired temperature, to prevent condensation.

The stacks are thermostatically controlled to obtain desired temperature by means of thermostat at two points on the ducts and one point in the cold air inlet. The air discharging from the ducts is deflected against the glass cur-



DETAIL OF ROOF HOUSE FOR STEAMING ROOM, PLANT OF JULIUS KAYSER & CO.

tains on the sides of the hoods for two reasons—one to prevent the heavy inrush of air, annoying the operators, and, secondly, to keep the glass from sweating.

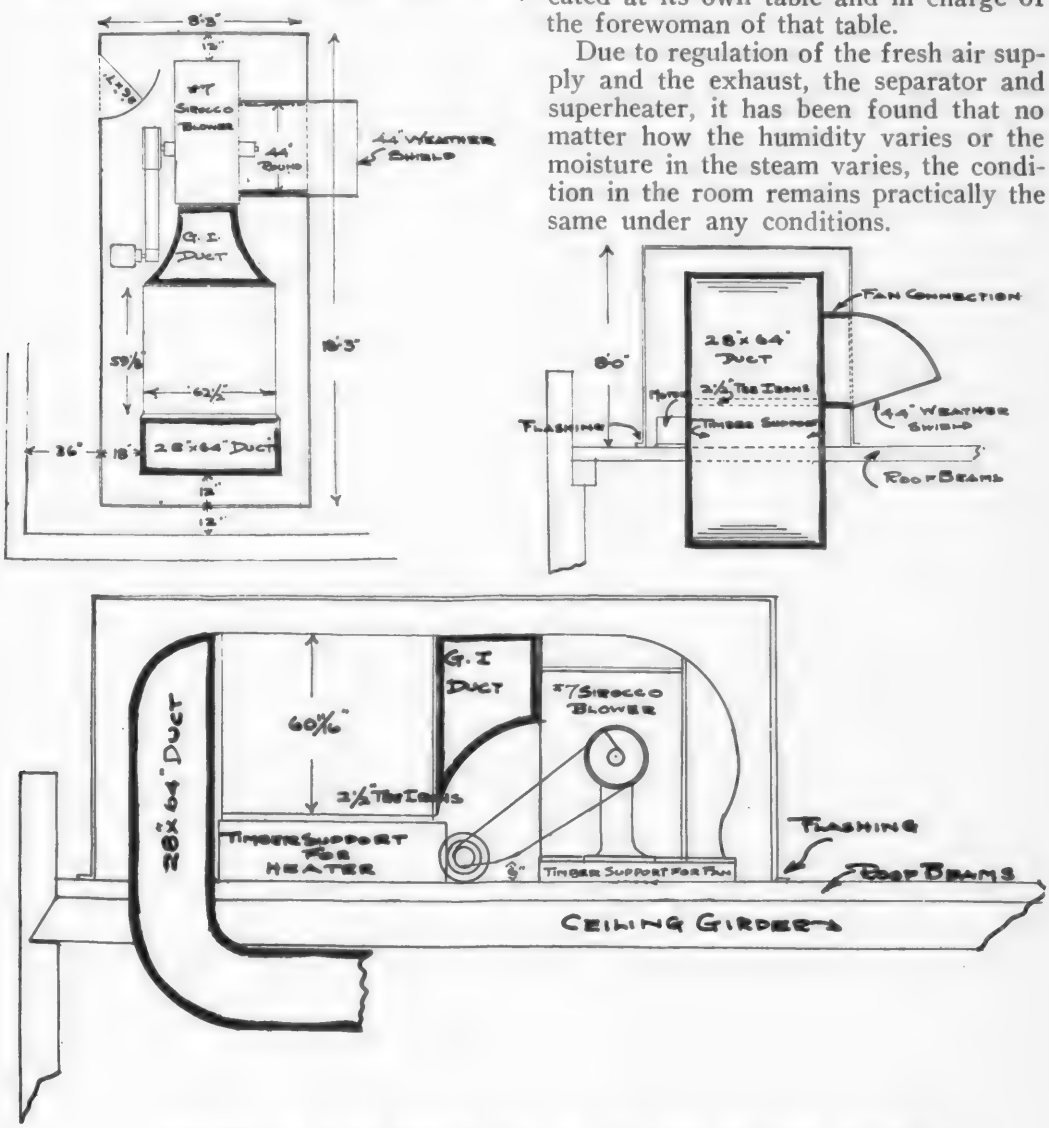
To protect the girls from the steam and to remove the steam from the room, a series or hoods was designed with special angles and with special aprons, and the rising steam was removed by means of vertical discharge disc fans, having a capacity of 50% greater than the capacity of the fresh air. It was found after the operation was started that the exhaust fans did not remove the air rapidly enough and the fans that had been in were doubled on the hoods, and horizontal discharge fans were placed on four hoods, in that way doubling the exhausting apparatus: so that it now has a capacity of almost three times the fresh air fan.

All the discharge outlets on the roof have been thoroughly insulated, as the steam was found to condense on these after it left the fan and to drip back on the tables.

All edges on the hoods and under the curtains have drip pipes and leader pipes, to carry away any moisture which might condense on them.

Each exhaust fan is separately controlled with a variable speed rheostat located at its own table and in charge of the forewoman of that table.

Due to regulation of the fresh air supply and the exhaust, the separator and superheater, it has been found that no matter how the humidity varies or the moisture in the steam varies, the condition in the room remains practically the same under any conditions.



DETAILS OF ROOF HOUSE AND OF FAN AND HEATER CASINGS.

The work has been installed, and has been in operation now for the last three or four months and is giving greater satisfaction than the owners or engineers had anticipated, although they had been very sanguine of good results.

The system, including the room itself, was designed and the entire mechanical installation was installed by W. L. Fleisher & Co., Inc., New York, this firm having been experimenting with this proposition for the last five or six years.

The Design of Air Ducts

NEW CHARTS BASED ON A LOWER COEFFICIENT OF FRICTION, AS DETERMINED BY TESTS.

By L. A. Harding.

The general form of the expression for the loss of head measured by the height of a column (in feet) of the medium flowing in a pipe is:

$$h_x = f \frac{L\,R}{A} \frac{v^2}{2g} \quad \ldots\ldots (1)$$

in which

h_x = head lost in feet.
L = length of pipe or duct in feet.
R = perimeter of pipe or duct in feet.
A = area of pipe or duct in square feet.
LR = area of rubbing surface in square feet.
f = coefficient of friction.
v = velocity of flow (average over the cross section) in feet per second.
g = 32.16.
$\frac{v^2}{2g}$ = the velocity head.

Experiments on the flow of air in smooth sheet steel ducts, varying in size from 12 in. to 48 in. in diameter and with velocities ranging from 1,000 to 2,400 ft. per minute, show that the average value of f is 0.0035. The value of f that has been used by various manufacturers in the calculation of published tables in the past is approximately 0.0064 and is undoubtedly too high.

If the measurements for head lost are made or stated in inches of water, formula (1) becomes

$$h_x = \frac{h \times K}{d} = f \frac{L\,R}{A} \times \frac{v^2}{2g} \text{ or}$$

$$h = \frac{d}{K} \times f \times \frac{L\,R}{A} \times \frac{v^2}{2g} \quad \ldots\ldots (2)$$

in which

h = head lost, measured in inches of water.
d = density of the air flowing (weight per cubic foot).
K = density of the water in the U tube.

For a temperature of 70°F. formula (2) becomes

$$h = 0.0000186\ f \frac{L\,R}{A} v^2$$

and for round ducts 100 ft. long

$$h = 0.00744\ f \frac{v^2}{D}$$

in which D = diameter of the duct in feet. If f = 0.0035, then $h = 0.000026 \frac{v^2}{D}$

Let P = pressure loss in pounds per square inch, and p = pressure loss in ounces per square ~~inch~~.

$$P = 9\,p. \quad h_x = \frac{P}{d} = \frac{9\,p}{d}$$

Substituting in Equation (1) we have

$$p = \frac{d\,f}{9} \times \frac{L\,R}{A} \times \frac{v^2}{2g} \quad \ldots\ldots (3)$$

as the loss in pressure, stated in ounces per square inch.

For a temperature of 70°F. (d = 0.075), L = 100 ft. and a value of f

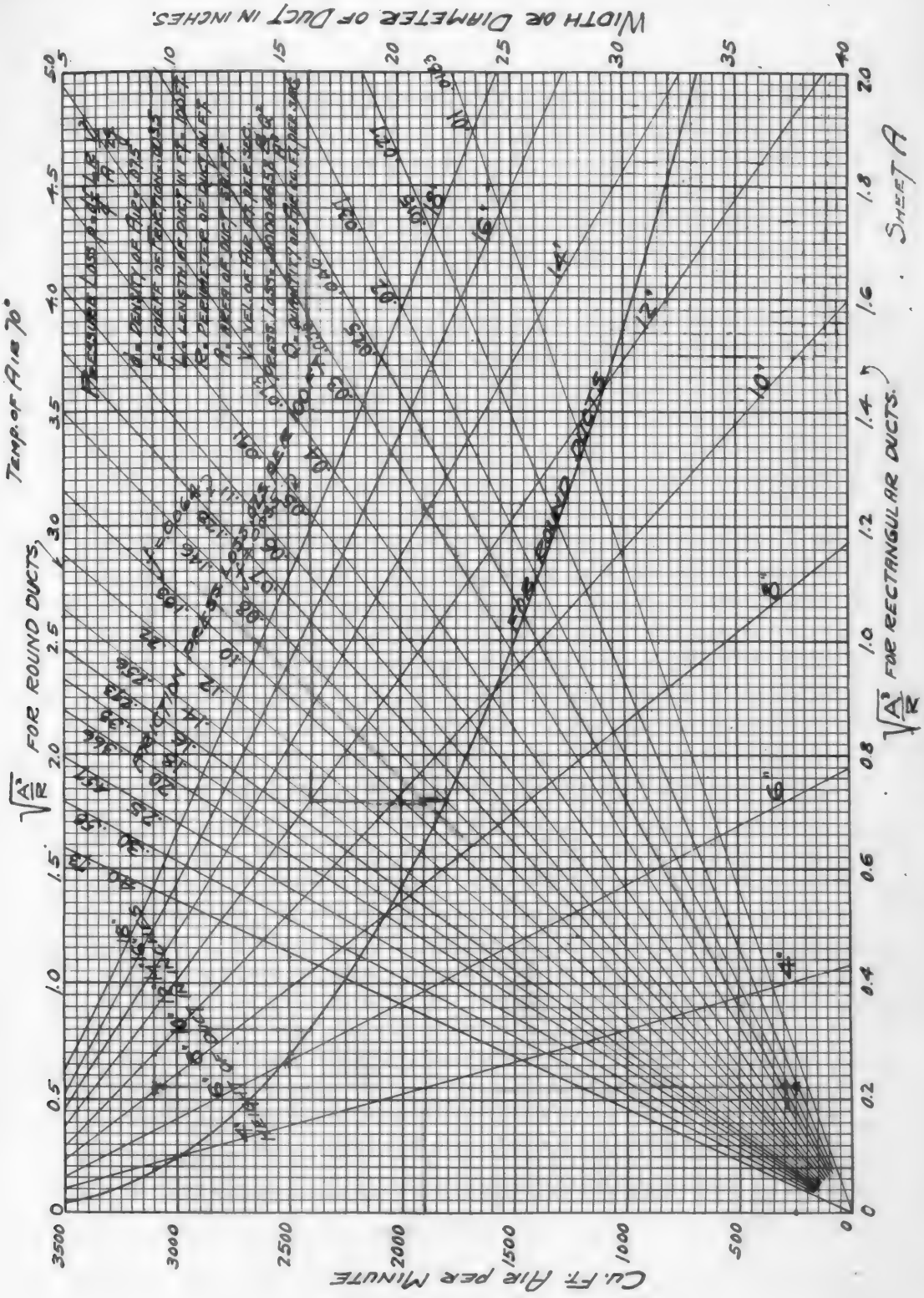


CHART A FOR DESIGN OF VENTILATING DUCTS.

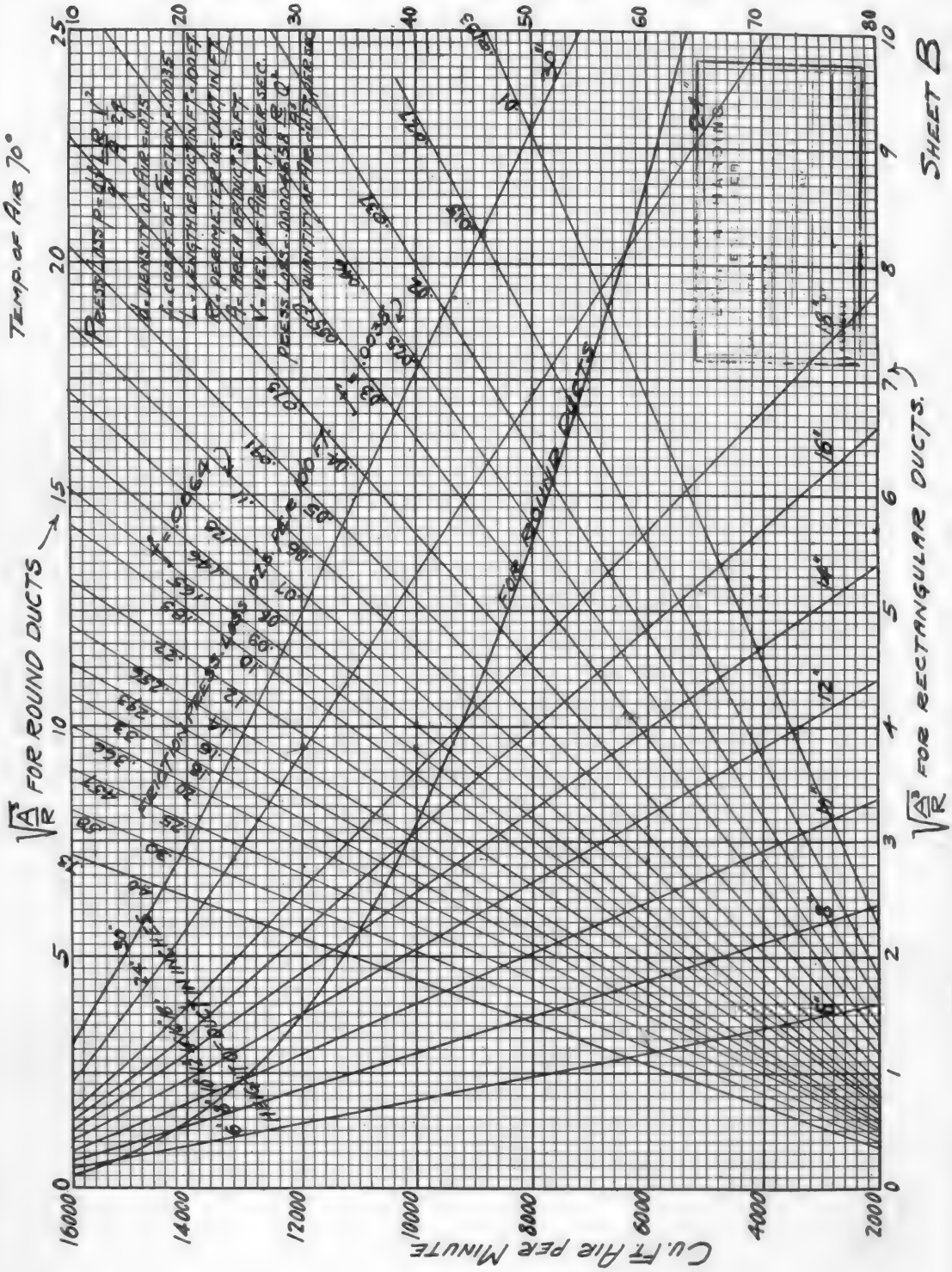

WIDTH OR DIAMETER OF DUCT IN INCHES.
Cu. Ft Air per Minute
$\sqrt{\frac{A^3}{R}}$ FOR ROUND DUCTS
$\sqrt{\frac{A^3}{R}}$ FOR RECTANGULAR DUCTS.
Temp. of Air 70°
SHEET B
FOR SQUARE DUCTS

CHART B FOR DESIGN OF VENTILATING DUCTS.

$= 0.0035$, we have $p = 0.000046 \times \frac{R}{A} \times v^2$.

If Q = the cubic feet of flow per second, then

$$p = 0.000046 \frac{R}{A^3} \times Q^2 \ldots\ldots (3)$$

$$\text{or } Q = \frac{1}{0.0068} \sqrt{p} \times \sqrt{\frac{A^3}{R}} \ldots (4)$$

For round ducts 100 ft. long, temperature 70° F.

$$p = 0.000184 \frac{v^2}{D}$$

or, if V = velocity in feet per minute,

$$p = 0.0000000511 \frac{V^2}{D}$$

$$\text{or } p = \frac{L}{71\,D} \left(\frac{V}{5175} \right)^2 \ldots\ldots (5)$$

This latter formula is usually stated as

$$p = \frac{L}{50\,D} \left(\frac{V}{5175} \right)^2$$

for smooth ducts and corresponds to a coefficient of friction of $f = 0.0064$ (approx.), previously mentioned.

The charts accompanying this article were calculated by means of equation (4). It was thought best to plot the charts for a value of $f = 0.0035$, corresponding to smooth ducts and, in using the charts, to add a percentage which, in the judgment of the designer, would cover the increased friction due to rough joints, poor alignment, etc.

In this connection the writer would recommend the addition of at least 25% to the friction loss as read from the charts for the average well-constructed duct layout when proper allowances has been made for the ells or turns and losses through the register grills.

EXAMPLE IN THE USE OF THE CHARTS.

Let it be required to proportion the "trunk line" air duct layout as shown by the accompanying figure.

The amounts of air to be delivered by the various registers, as well as the amount carried by the various sections of the duct, are given on the sketch. The ducts to be rectangular.

The measured length of the main duct from the reheater to the farthest outlet, branch L, located on the third floor, is 155 ft. The maximum velocity in the last section, L, to be limited to 600 ft. per minute and the allowable velocity through the free area of the register grills, 400 ft. per minute. The main duct to be designed for equal friction pressure loss per foot of length. Friction allowance $f = 0.0035 + 25\%$.

Inasmuch as the maximum velocity in the last section is fixed and all sections are to be designed for the same pressure loss per foot of length, it is first necessary to determine the size of the last section in order to find the pressure loss per 100 ft. for which the entire length of duct is to be designed.

The last section, L, is to carry 250 cu. ft. per minute.

Area $= 250 \div 600 = 0.416$ sq. ft. or 60.0 sq. in., say, 8 in. × 8 in. section.

Referring to Chart 1, locate on the right hand side of the chart the width of duct 8 in., pass horizontally to the left and intersect the diagonal line marked 8 in. (height of duct), then down to the intersection of the horizontal line for 250 cu. ft. air per minute. The intersection falls on the diagonal line for 0.025 oz. loss per 100 ft. for a coefficient $f = 0.0035$.

If we make an additional allowance of 25% for rough joints, etc., the probable actual loss per 100 ft. will be 0.025 + 25%, or 0.03 oz. per 100 ft.

All readings for the main duct section will then be made from the 0.03 oz. line, instead of from the 0.025 oz. line, the method being to locate the cubic feet of air flow on the left hand side of the diagram or chart, then to read horizontally to the right to the intersection with the 0.03 oz. line, then vertically up or down to the height of duct desired, then to the right for the required width.

The sizes for the various duct sections for the layout in question were determined in this manner and are given in Table 1.

ALLOWANCE FOR ELLS OR TURNS.

There are two ways or methods in use for making allowance for the friction of turns, as given by Table 2.

The following data on friction pressure loss by entry to branch ducts was

determined by the writer from experiments conducted in 1911. The size of the main was 24 in., and the size of the branches, 9½-in. in diameter, respectively, for velocities ranging from 1,000 to 2,000 ft. per minute.

TABLE 3—FRICTION PRESSURE LOSS DETERMINED FROM EXPERIMENTS.

Angle of the branch, degrees.	Loss in ounces per square inches = table x velocity pressure.
15	0.09
30	0.17
45	0.22
60	0.44

Allowance for ell, Section B: R = 1.1 W. Width of duct, 3.08 ft. Add 3.08 x 9 = 27 ft.

For ell, Section F: R = 1.1 W. Width of duct, 2.75 ft. Add 2.75 x 9 = 25 ft.

For ell, Section F, at base of riser: R = 0.55 W. Width of duct, 2.75 ft. Add 2.75 x 27 = 73 ft.

For ell, Section G: R = 0.4 W. Width of duct, 1.54 ft. Add 1.5 x 40 = 60 ft.

For ell, Section H: R = W. Width of duct, 1.54 ft. Add 1.54 x 10, say, 16 ft.

For ell, Section L: R = W. Width of duct, 0.67 ft. Add 0.67 x 10, say 7 ft.

The total equivalent length of duct for figuring the friction is 27 + 25 + 73 + 60 + 16 + 7 + 155 = 363 ft.

The total friction pressure loss for the main, including allowance for the ells is, therefore:

$$\frac{363}{100} \times 0.03 = 0.109 \text{ oz.}$$

The final velocity pressure through the free area of the register grill, at 400 ft. per minute, is 0.006 oz. The loss through the register grill, where the free area is equal to one-half the total area is, approximately, equal to 1.5 × the velocity pressure, or 1.5 × 0.006 = 0.009 oz.

The total pressure required at the beginning of the main duct will be the sum of the lost heads or pressures, plus the final velocity pressure, or 0.009 + 0.109 + 0.006 = 0.124 oz.

The total pressure at the last register, Section L, will be 0.006 + 0.009 = 0.015 oz.

Draw a horizontal line to any convenient scale, representing a length equal to 363 ft., as shown by the accompanying figure. At the left hand end on the vertical, lay off 0.015 oz. to scale. At the right-hand end on the vertical lay off 0.124 oz. to the same scale. A line connecting these two points will give the total pressure, to scale, at any point in the main and is convenient to use in ascertaining the total pressure at any point where a branch main or branch is taken off.

For example, take the branch main in the basement, M to R. The total pressure available in the main duct where this branch is taken off is 0.095 oz. The total pressure at the last register, Section R, is 0.015 oz. The allowable pressure loss in this branch is, therefore, 0.095 — 0.015 = 0.08 oz. The total equivalent length of the branch, including two ells, is 72 ft., which gives 0.08 × (100 ÷ 72) = 0.11 oz. per 100 ft. as allowable loss. As this includes the 25% allowance for rough joints, etc., the corresponding pressure loss line to use on the chart will be 0.11 ÷ 1.25 = 0.09.

Referring to Chart 1 and reading to the interpolated 0.09 oz. line in each

TABLE 1—SIZES FOR VARIOUS DUCT SECTIONS SHOWN IN SKETCH.

Section	Cubic Feet Per Minute.	Size Duct. Inches	Area, Square Feet.	Velocity, Feet Per Minute.	Velocity Pressure, Ounces.
A	15000	30 x53	11.04	1358	0.066
B	7500	24 x37	6.2	1210	.....
C	7100	24 x35½	5.9	1200	0.053
D	6600	24 x33	5.5	1200	.....
E	6300	24 x32	5.3	1182	.....
F	4400	18 x33	4.1	1068	0.042
G	2200	18 x18½	2.3	952	.....
H	1300	12 x18½	1.5	850	.....
I	1000	12 x14½	1.2	826	.....
K	500	8½x12	0.71	706	.....
L	250	8 x 8	0.41	600	0.013

TABLE 2—ALLOWANCES FOR ELLS OR TURNS IN FIGURING AIR DUCTS.

	Ratio Throat radius / diameter or width R/W	Number of diameters or widths to add to measured length of duct.	Loss in ounces per square inch = table x velocity Pressure.
Sharp right angle turns.....	——	——	1.10
Sharp angle turns, 135°.....	——	——	0.30
Right angle turns.....	1.75 to 4	5	0.15
" " "	1.5	6	
" " "	1.2	9	
" " "	1.0	10	0.25
" " "	0.75	16	
" " "	0.50	30	
" " "	0.30	58	
" " "	0.25	68	

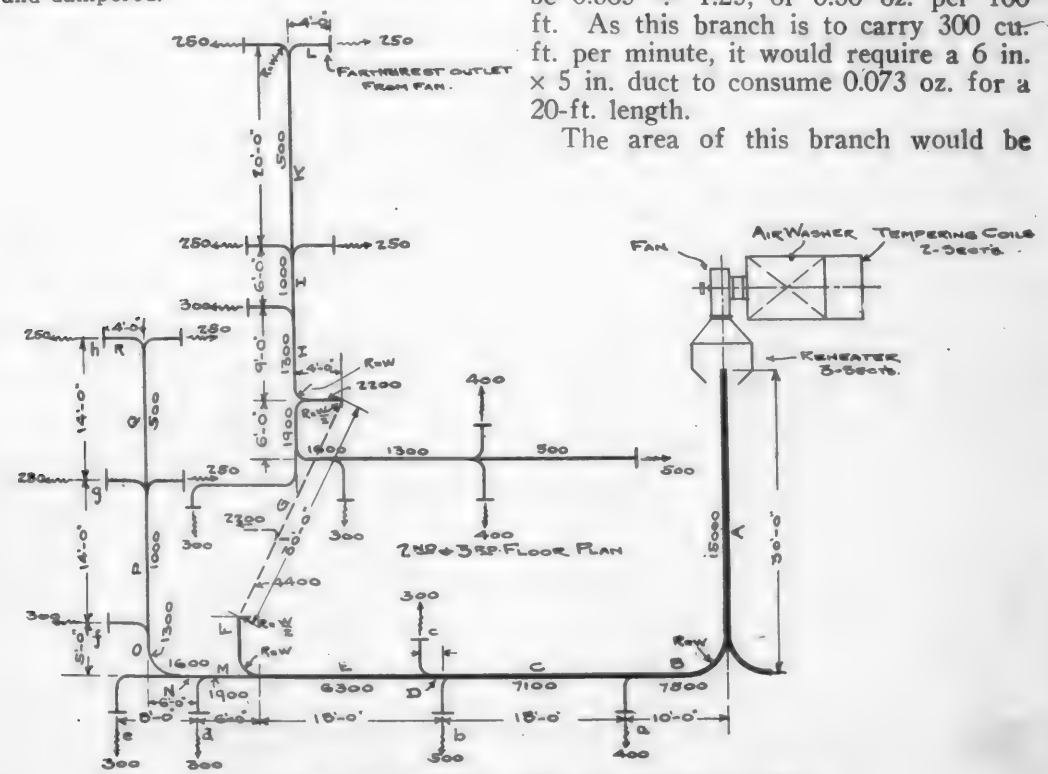
case, we have the following sizes for this branch:

Section	Cubic feet per minute.	Size, inches.
M	1900	12x16
N	1600	12x14
O	1300	10x14½
P	1000	10x11½
Q	500	8x 8
R	250	6x 7*

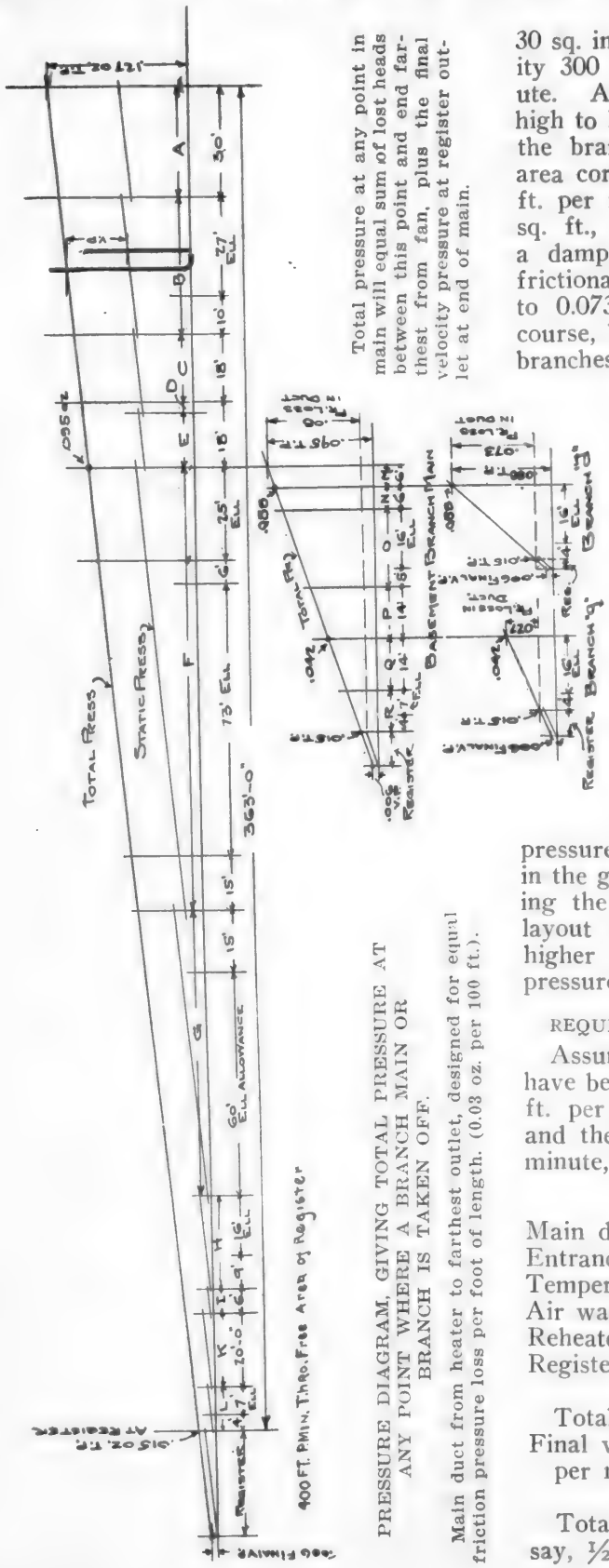
*This section to be made 6 in. x 10 in. and dampered.

Branch d. The length of this branch, including allowance for one ell is 20 ft. The total pressure in the branch main at the point where d is taken off is 0.088 oz. The total pressure at the end of the branch at the register is 0.015 oz. We may, therefore, lose 0.088 — 0.015, or 0.073 oz. in 20 ft., or 0.073 × (100 ÷ 20) = 0.365 oz. per 100 ft. The corresponding diagonal pressure line to use on the chart will be 0.365 ÷ 1.25, or 0.30 oz. per 100 ft. As this branch is to carry 300 cu. ft. per minute, it would require a 6 in. × 5 in. duct to consume 0.073 oz. for a 20-ft. length.

The area of this branch would be



PLAN OF LAYOUT USED IN CALCULATIONS.


Total Press.
Static Press.
363'-0"
400 Ft. Min. Thro. Free Area of Register
Basement Branch Main
Register Branch No. 1
Total pressure at any point in main will equal sum of lost heads between this point and end farthest from fan, plus the final velocity pressure at register outlet at end of main.

PRESSURE DIAGRAM, GIVING TOTAL PRESSURE AT ANY POINT WHERE A BRANCH MAIN OR BRANCH IS TAKEN OFF.

Main duct from heater to farthest outlet, designed for equal friction pressure loss per foot of length. (0.03 oz. per 100 ft.).

30 sq. in., or 0.208 sq. ft., and the velocity 300 ÷ 0.208 = 1,442 ft. per minute. As this velocity is entirely too high to lead direct into the register box, the branch should be enlarged to an area corresponding to a velocity of 600 ft. per minute, or 300 ÷ 600 = 0.50 sq. ft., or 6 in. × 12 in. section, and a damper provided to give the extra frictional resistance to bring the loss up to 0.073 oz. This condition will, of course, be found to exist for all of the branches leading to the registers, with the exception of the last one, L, at the end of the main duct.

The extra resistance may also be provided by taking off the branch at such an angle that the pressure loss by entry to the branch will make up the extra resistance required. This method, however, is somewhat uncertain.

The pressure loss by entry from the plenum chamber to a duct, in the single duct system of distribution, is assumed by some engineers to be 0.45 of the velocity pressure in the duct. The pressure loss in the gradually-tapered section connecting the heater and main duct, in the layout shown, will probably not run higher than one-third the velocity pressure or 1/3 of 0.066, say, 0.02 oz.

REQUIRED PRESSURE RATING OF FAN.

Assuming that the heater sections have been figured for a velocity of 1,200 ft. per minute through the clear area and the washer for 400 to 500 ft. per minute, the total losses will be:

	Oz.
Main duct	0.109
Entrance to main duct	0.020
Tempering coils (eight rows pipe)	0.064
Air washer	0.150
Reheater (twelve rows pipe)	0.078
Register grill	0.009
Total loss by friction	0.430
Final velocity pressure at 400 ft. per minute	0.006
Total	0.436

say, ½-oz. or ⅞-in. water.

Rules Promulgated for the Ventilation of Picture Theatres

Definite rules for the ventilation of motion and other picture show places have been promulgated by the American Society of Heating and Ventilating Engineers and are given herewith. They were originally prepared by a special committee of the society, composed of Frank T. Chapman, chairman; Bert C. Davis, Joseph Graham, J. W. H. Myrick, Thomas Barwick, E. L. Hogan and W. W. Macon. Upon the presentation of a tentative draft of the rules at the recent annual meeting of the heating engineers' society, the discussion brought out the need of certain minor modifications. These changes have now been made, and the proposed requirements, as amended, are offered not only to engineers, but to the public, including owners of picture theatres, boards of health and town and city councils, which are in need of information to guide them in determining the construction and operation of such places.

It is the purpose of the society to give the rules as wide a publicity as possible to meet the serious situation existing in scores of cities and towns where moving show places are being built and operated in increasing numbers, with little, if any, regard to the health of their patrons.

With a view to suggesting minimum requirements that are practical to secure the following recommendations are made as standards for legislation to cover this important phase of the needed general regulations for motion picture show places.

Minimum Ventilation Standards.

FLOOR AREA PER OCCUPANT.

A minimum of 4⅓ sq. ft. of floor area as a seating space, per occupant, exclusive of aisles and public passageways, shall be provided in the audience hall.

CUBIC SPACE FOR OCCUPANT.

A minimum of 80 cu. ft. of air space per occupant shall be provided in the audience hall.

QUANTITY OF OUTDOOR AIR.

A positive supply of outdoor air from an uncontaminated source shall be provided the audience hall at all times while the show place is open to the public, and the quantity of this positive supply of outdoor air shall be based on a minimum requirement of 15 cu. ft. per minute, per occupant.*

TEMPERATURE.

The temperature of the air in the audience hall shall at all times, while the show place is open to the public, be maintained throughout at the breathing line (persons being seated) within the range of 62° F. to 70° F. (except when the outside temperature is sufficiently high not to require the air supply for ventilation to be heated). The temperature, distribution and diffusion of the supplied outdoor air shall be such as to maintain the temperature requirement without uncomfortable draughts.

DIRECT HEAT SOURCES.

Any good heat source which does not contaminate the air will be accepted to supplement the warmed outdoor air supply. Gas radiators are prohibited.

MACHINE BOOTH VENTILATION.

Enclosures or booths for the motion picture machines shall be provided with special exhaust ventilation, with a capacity to exhaust at all times not less than 60 cu. ft. of air per minute through a one-machine booth, not less than 90 cu. ft. of air per minute through a two-machine booth and not less than 120 cu. ft. of air per minute through a three-machine booth.

This requirement shall include a number of small metal screened openings (equipped with special dampers and automatic appliance with fusible link to automatically close tight in case of fire in booth) on the sides of the booth near the bottom of same, aggregating 180 sq. in. for a one-machine booth, 210 sq. in. for a two-machine booth; and 240 sq. in. for a three-machine booth; and this booth exhaust ventilation shall also include a metal or other fireproof flue extending from the top or side at top of booth and carried to proper place of discharge outdoors. The ventilation should be augmented by mechanical or other means so as to exhaust at least the quantity of air herein stated. The size of this special fireproof vent flue shall be not less than 96 sq. in. clear area for a one-

*The ordinance in force in the city of Chicago at the present time requires that the air in the auditorium in the class of buildings in which motion picture show places are included shall be changed so as to supply for each person for whom seating accommodation is provided at least 1,500 cu. ft. of air per hour for new buildings, and at least 1,200 cu. ft. of air per hour for buildings constructed prior to the passage of the ordinance, which requirements the Illinois chapter of the society considers practical to obtain and desirable to require by legislation for motion picture show places. Higher standards of ventilation than set forth as minimum in the committee's report are urged wherever possible to obtain.

machine booth, not less than 120 sq. in. clear area for a two-machine booth, and not less than 144 sq. in. clear area for a three-machine booth, and this special vent flue shall be provided with an adjustable damper operated from the booth and equipped with an automatic appliance and a fusible link to operate to automatically open damper wide in case of fire in the booth. The machine booth ventilation shall be kept in operation at all times when the booth is in use.

General questions—such as inspection, method of enforcing the requirements, penalties for non-compliance, etc., are left for each state, town or city to determine, although some suggestions covering these matters are made in the following general remarks: (Inspection, method of enforcing and penalties are vitally important and should have careful consideration)

GENERAL REMARKS.

It will be noted that the foregoing regulations are simple and that violations may be readily detected, also that care has been exercised to leave large latitude for design of the ventilating apparatus.

It should be especially noted that the foregoing regulations call for a minimum of all requirements as compulsory, and that it should be the aim of the administrative department having enforcement of the regulations in charge to encourage motion picture show owners and managers to provide as comprehensive, liberal and high-class equipment as possible, with a view to catering to the comfort and health of the patrons and thus add to the popularity of the show place as compared with others which may have barely come within the legal requirements.

The minimum of 4⅓ sq. ft. of floor area per occupant called for by the recommended regulations considers the seating space to be 32 in. back to back of seats, with a width for individual seat of 20 in. The 32-in. has been demonstrated as desirable to provide for reasonable passageway. The general regulations would probably cover these dimensions.

The 80 cu. ft. of air space per occupant, called for by the recommended regulations, has been arrived at as a minimum cubic space per individual under which fairly good air conditions can be secured, and it will be noted that this requirement, when taken in conjunction with the floor space requirement, automatically provides that the ceiling height in the small show place will average about 16 ft. in the clear as a minimum.

Elimination of dust from the air supply by means of air filters or air washers is desirable under the best conditions and is imperative under some conditions of especially dusty air supply. This question is dealt with by suggestion in the following general clauses. The controlling of relative humidity is desirable to obtain whenever possible, but the committee decided to omit from the regulations any humidity requirement.

The machine booth ventilation, as per recommended regulations, would be improved, especially for summer conditions, by providing a duct connection from out-of-doors to the bottom of the booth, for the introduction of outdoor air directly to the booth, such a duct, to equal in size the special exhaust duct referred to in regulations for the different size booths, should be made of metal and should pitch from the booth downward to the outside wall of the building and be provided at the inlet with a weather protection hood. An adjustable damper should be placed in this duct connection near the booth, under control in the booth and independently equipped with an automatic appliance and a fusible link to operate to close automatically in case of fire in the booth.

ENFORCEMENT OF LAW.

Strong emphasis is placed on the need of having the administrative feature of legislation, of the kind here advocated, placed in the control of a responsible department, such as State Board of Health, in the case of villages, but preferably some other responsible local department for cities, and that such department be supplied with a special inspector or inspectors experienced in heating, ventilation and sanitation, and that such department be given reasonable latitude by legislation, such as to require approval of plans preceding installation, or to require special extra equipment for special cases; such as dust filters for air supply, where the air supply is specially dust laden; exhaust ventilation of toilets where building laws do not properly cover this matter; fans in auditorium proper to keep the aid in motion, where diffusion is insufficient, etc., it being made clear in the legislation that such latitude should in no case include the right to reduce the stated minimum requirements recommended for legislation. The administrative department should also be given the support of other local or state departments, as the case may be, such as the Fire Department, Police Department, Health Department, etc.

Definite penalties, such as fines for minor offences, up to a suspension or revoking of licenses for important or repeated violations, are certainly indispensable to get practical results.

Measuring Air Velocities Through Registers.

An effort to establish a standard practice for measuring air velocities through registers, made at the recent annual meeting of the heating engineers' society, led to a discussion that showed not only the varying methods followed in this connection but also the difficulties in the way of securing accurate results.

The proposals as made by a special committee appointed for the purpose were as follows:

1. The opening shall be divided into equal rectangular area, no side of which shall be over 10 in. long, excepting where this would require more than ten readings, in which case the opening shall be divided into twelve equal areas.

2. Readings are to be taken in every case at the center of every area.

3. Readings are to be one-half minute duration, the anemometer being held at the register base or in the plane of the opening.

4. Where the diffusers are used, a total area is to be computed on the basis of the periphery of the diffuser.

5. The average of the readings are to be considered as the average velocity at the opening. Where negative velocities are found they are to be deducted in arriving at the average velocity.

6. In computing volume, the net area of opening is to be taken, the volume to be considered as the product of the average velocity and the net area of the opening.

DISCUSSION.

PROF. KENT: In connection with dividing the opening into rectangular areas, I do not think the committee has considered the possibility of the outlets being round. It is going to be a matter of some difficulty to divide a circle into twelve rectangular openings.

MR. HASLETT: I must confess that we did not take that into consideration. I do not think, however, that your committee has seen a round register in recent years.

MR. WHITTEN: Referring to the clause that readings are to be taken at the center of each area, the method adopted by the Massachusetts District Police, in making their measurements, has been to eliminate from the measured surface several inches of the lower portion of the inlet, as they have found practically no flow there whatever. If that were included, it would bring the center several inches, perhaps 6 in., nearer this neutral area. In Massachusetts, in figuring the area of the inlet opening, an area 6 in. high of the full width of the opening, is deducted from the surface.

MR. LYLE: That point was discussed by the committee in formulating this report and we could not see the difference between deducting a certain amount of area from the bottom, or wherever there was no flow, and the method we have proposed of taking an average for the whole surface of the register. In fact, it seemed to us to be wrong to make any deductions, for the reason that there are times when we have a negative flow, due to an eddy current of air actually going into the register instead of going out. In such a case, if you consider the portion in which you have no outward flow as being wall surface, being blanked off, then your velocity is too high in the other portions.

MR. HASLETT: I do not think it would be possible to establish a rule of dead space, for the reason that it depends on the thickness of the wall and on the height of the register. If your register is high and you have a thick wall, you are going to have a larger dead space every time. And very likely, the thicker the wall, the more chance is there for an inflow of air. To establish a dead space at the bottom of that register would be impossible, because you are likely to find dead spaces at other points than at the bottom. It depends upon the delivery of the air into the flue.

W. W. MACON: Referring to the measurements when diffusers are used, it seems to me that the type of diffuser might be such that the computed area would be very misleading. I think it would be better to leave off the diffuser until the flow of air is ascertained. In that case, the error would not be nearly so great as when the readings were taken with an odd-shaped diffuser.

MR. LEWIS: I would like to ask the committee if it took into consideration internal diffusers, such as those described by Mr. West two years ago (published in THE HEATING AND VENTILATING MAGAZINE for December, 1910). Mr. West designed an internal diffuser which gave practically an even distribution of air all over the register face. That would seem to have some bearing on the dead air space in the register.

PROF. KENT: I did not hear in the reading of the report any reasons for the adoption of these rules. No experiments are recorded and no information is given of the amount of error to be expected in the use of anemometers.

MR. ARMSTRONG: I think it will be a mistake to adopt the anemometer as an instrument for use in this connection. It has been thrown out by the Navy Department and Treasury Department and by the Institute of Mining Engineers.

MR. HASLETT: In our report the use of an anemometer is suggested simply as a method, because that is the instrument in ordinary

use. There may be other ways just as good or better.

MR. LYLE: We have a large number of comparative records obtained from Pitot tube and from anemometers. I believe we know the percentage of error with a Pitot tube very accurately. A comparison of the Pitot tube records with the anemometer records shows a wide variation. In our own work, in determining whether or not our systems are properly balanced, that is, whether we were delivering to each individual room the proportion of air that was originally intended for it, we are using the Pitot tube and working on low pressures. We balance our systems that way. We find that we can do the work in about half the time as when using the anemometer. We have not found any customer, however, who would not take the anemometer reading as compared with that of the Pitot tube. You can, at least, see the anemometer wheel go round, but you cannot see the operation of the Pitot tube.

MR. HASLETT: As I understand the suggestion, it is that if the anemometer is held 2 in. away from the register face, no deduction is to be made for the mesh.

MR. LEWIS: I do not see why, if it is held up close, it should make any great difference.

WM. J. BALDWIN: I do not believe one can measure air velocities properly through a register face with either an anemometer or with a Pitot tube. When one uses an anemometer over the face of a register, he gets the velocity through an opening which is about the velocity due to the pressure in the flue. It is not the true velocity for the entire area of the register. The little high velocity jet, coming through a hole in the register face, impinges on the anemometer wheel and gives it an uncertain and exaggerated movement and, we know, that working over the greater area we do not get the true velocity over the whole face of the register. I frequently make measurements by putting a stiff paper cone over the whole register face, using an outlet about one-fourth to one-third the area of the register. In this manner I can get an approximate measurement of the air coming through the register.

The arrangement may offer a little resistance to the flow of the air, but when some contractor is trying to prove that a certain quantity of air is coming in, and he gets that quantity with this cone arrangement, it is reasonable to suppose that he has fulfilled his contract. In other words, the resistance due to the cone is something in favor of the man who is paying the bill. What I want to point out is that the measurement, at this round opening in the cone, is very nearly the true measurement of what comes through the register.

I have tried Pitot tubes, but the pressures are so small that the capillary attraction upset the Pitot tube tests. Therefore, I do not believe it is possible to get the true quantities of air close to the face of a register with either the Pitot tube or with an anemometer. I believe the air should be measured some distance from the register or in the vertical duct leading to the register.

MR. LEWIS: In a number of States there are laws which require the inspectors to go around and see that the contracts have been fulfilled. It is for the benefit of these contractors and inspectors to have some standard method of measurement. They generally use an anemometer and it seems to me that for purposes of comparison it is fair to use an anemometer.

MR. HASLETT: I would say that we took into consideration the use of a hood or cornucopia, as suggested by Mr. Baldwin, and while that may be a good method, we thought that in large buildings, where there are different sizes of registers, the equipment for testing a building would have to be rather extensive.

As for the resistance, some one has suggested that if a 2-in. nozzle, for instance, were used to throw water across this room, and you should substitute a 1¾-in nozzle, you would throw the water much farther.

However, the committee did not undertake to recommend what instrument should be used, only that if an anemometer were to be used, how it were best to use it.

MR. WILLIAMS: Referring to the portion of the committee's report regarding net area of register openings, can you deduct anything in the case of a wire mesh register either round wire or square, ¼-in., woven wire mesh? I have found that you get practically the same readings with the mesh and without.

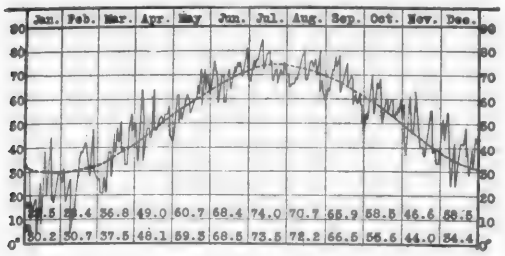
MR. HASLETT: The point raised by Mr. Lewis need not cause the report to be changed. If the customer or inspector chooses to avail himself of the protection Mr. Lewis suggests, then no deduction should be made. If not, then it places the engineer in possession of some test data.

Weather in New York City During 1912.

Following a custom established two years ago, the New York City office of the United States Weather Bureau has published a meteorological summary for 1912, with comparative data. A number of the larger cities publish similar data. In the case of the New York publication, the data is accompanied by charts (which are reproduced herewith) permitting the significant features of the weather during the year to be easily noted.

For instance, in connection with the

temperature curve, it is seen that January and February of last year were unusually cold. In fact, there was a total of 17 hours when the temperature was at zero or below. Temperature departures were small from March to September, but October, Novem-



TEMPERATURE VARIATIONS IN NEW YORK CITY DURING 1912.

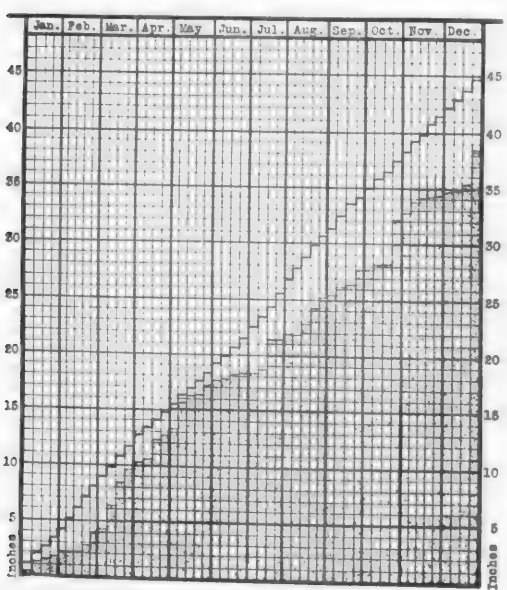
Broken line represents general fluctuation of daily mean temperature.

Dotted line, the annual curve of normal temperature.

ber and December were sufficiently warm to compensate for January and February, so that at the close of the year there was a slight accumulated excess of temperature.

The precipitation was deficient, being 6.26 in. below normal for the year.

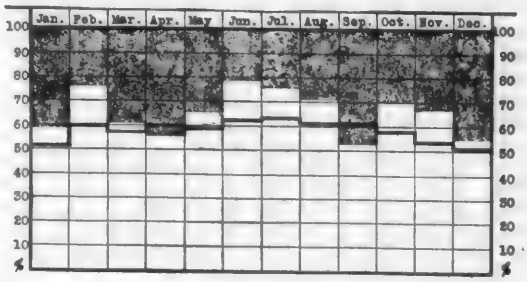
The average hourly wind movement, 17.7 miles, the bureau states, seems extraordinary when compared with the normal, 11.5, but this difference is probably almost en-



PRECIPITATION IN NEW YORK CITY DURING 1912.

Shaded columns represent accumulated depth in inches for 1912.

Heavy broken line, the normal.



SUNSHINE IN NEW YORK CITY DURING 1912.

Unshaded columns represent of possible by months for 1912.

Heavy broken line represents normal for 18 years.

tirely due to a change in the elevation and exposure of the anemometer when the local weather bureau changed its location to 17 Battery Place, with its apparatus over 100 ft. higher, the elevation now being 454 ft.

Used Perfumed Air to Evade Ventilation Law.

Sprays of perfume from a battery of atomizers along the walls of a nickel show may fool the patrons of the house, but they do not deceive a little machine employed by the Chicago Health Department.

"It registers the carbon dioxide in the air," explained E. V. Hill, chief of the ventilation bureau, "and some of the samples taken contain more of it than our machine will register—in fact, one sample broke the register—but it always shows whether the air is fresh."

The city ordinances in Chicago prohibit more than ten parts of carbonic acid gas to 10,000 parts of air, and they require the introduction of 25 cu. ft. of fresh air per minute for each person in a theatre. Mr. Hill said that only thirty or forty of the 520 nickel shows in the city comply with these provisions. A number have been compelled to improve their ventilating apparatus, and others will be closed temporarily if that becomes necessary in the effort to force them into line.

A Correction.

In connection with the indirect heating stacks for the New York General Post Office, as described in last month's issue, it should be stated that Vento heaters were used throughout for the primary, secondary and tertiary stacks, 25,000 sq. ft. being installed. This type of heater was used in place of pipe coils.

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A. S. ARMAGNAC..... .....*President*
GUSTAVE PETERSEN.....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager

European Representative:
W. G. HOLLINWORTH, 304 High Holborn, London, W. C.

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CONSTRUCTIVE work of the first order is shown in the code promulgated by The American Society of Heating and Ventilating Engineers and designed to regulate the ventilation of picture theatres. The cramped quarters which, in so many cases, are being devoted to this form of entertainment, coupled with the facts now known regarding the astounding number of picture theatre patrons, present a condition, the seriousness of which is apparent to all, and it is not too much to say that the successful solution of this problem by any organization will alone justify its existence. Moreover, it is no time to delay action until a more perfect or more comprehensive code can be devised. Undoubtedly, further provisions and modifications will suggest themselves as additional details of the practical problems involved are studied. But the important point at the moment is to get into the hands of those responsible for the operation of picture theatres, and this includes not only the owners but town and city councils, boards of health, etc., the necessary requirements for such places, from a fresh air standpoint, and these are contained in the code now set forth by the heating engineers' society.

ACCORDING to a pamphlet lately published by the New York State Department of Labor, through the Bureau of Factory Inspection, the department lays down specifications, which, we understand, have all the force of law, relating to the design, construction and operation of exhaust systems for grinding, polishing, and buffing wheels. It is stated that one of the objects of the specifications is to prevent the construction of exhaust systems on such faulty designs as making the main suction duct much too small and not infrequently of the same size throughout its length, running the branch pipe into the main at right angles and sometimes at the bottom of the main, too small a fan, too small a discharge pipe from the fan, and too small a cyclone separator or dust collector, with the result that the suction is entirely inadequate to carry off the dust.

It has been the practice of the department, in connection with the enforcement of the State factory ventilation law, to approve or disapprove ventilating systems which owners have been notified to install. The present procedure, therefore, is something quite new in the department, and will very likely lead to a series of specifications for all classes of factory ventilation now under the supervision of the factory inspection bureau. This will be all the more feasible now that the bill creating a department of industrial hygiene in New York State has become a law.

THE CONSULTING ENGINEER

"The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

15—Use of O. S. Fittings on Hot Water Work.

QUESTION—What advantage is there in using O. S. fittings on hot water work?

ANSWER—There is none, as the lip simply forms an obstruction in the pipe which tends to increase the circulation in the radiator with reference to the main or riser, but a multiplicity of these fittings would tend to greatly decrease the circulation of the job as a whole. The enlargement of area of the fitting due to the introduction of the lip would produce the same effect if there were no projection at all.

One of the cardinal principles in the flow of fluids is that any sudden enlargement of area and reduction in velocity at any point produces a loss in head the same as friction, due to the action of the fluid against the side of the conduit.

16—Loss of Velocity Head in Air Chambers.

QUESTION—In a school building lately completed, we are having difficulty in obtaining a sufficient flow of air to the flues, although the fan and ducts are figured large enough to deliver the air at a very low velocity and less than ¾ oz. pressure. The ducts are run to brick chambers at the base of each flue which were left in the building inasmuch as these had been provided in the general contract to accommodate auxiliary stacks, but the building was afterward heated by direct radiation and only tempered air at 70 degrees F. was delivered to the flues. Can you suggest what is the matter?

ANSWER—The brick chambers are undoubtedly the cause of your trouble, due to the great decrease in velocity of the air entering the chamber. On this account an increase in velocity is necessary on leaving the chamber and entering the flues. The air is simply compressed in the chambers and in the flues, causing a loss in velocity head at both points.

If the chamber is blocked off so as to utilize only a portion equivalent to the duct area, thus maintaining the velocity, the losses in head will be eliminated and changed to velocity head, increasing the air delivery. Probably a sheet iron bottom can be placed in the chamber on a level with the entrance to the flues and with the bottom of the supply duct.

Downward Ventilation in a Rockford, Ill., School House.

A DISCUSSION.

Comments on the unique scheme for heating a school house in Rockford, Ill., described by Clinton E. Beery before the Heating Engineers' society at its recent annual meeting, are presented herewith. This scheme, which was published in THE HEATING AND VENTILATING MAGAZINE for March, 1913, included ceiling coils, supplemented by a specially-constructed diffuser, located at the center of the ceiling, through which the tempered air was admitted. Vent outlets were located near the floor at each corner of the room:

H. W. WHITTEN: I would like to ask Mr. Beery what method of humidifying was used in the Rockford school house.

MR. ENGLISH: I would like to ask Mr. Beery if it would not be a distinct advantage to have the additional outlet at the ceiling. At one time all the New York schools had air outlets at the ceiling and they were discontinued.

W. S. TIMMIS: The author states that there were no drafts in the room heated in the way he describes when the temperature of the incoming air was very slightly above that of the maintained temperature of the room and the velocity of the incoming air was low. I would like to ask how he accounts for the fact that there was no drop in temperature near the windows, although he has practically static conditions there. We observe in our work that when we have a static condition, the temperature near a window is lower than at other points in the room, causing down drafts at the window. I would like to ask if any tests were made with this installation for drafts near the windows.

W. W. MACON: I would like to ask what amount of relative humidity the author was able to have in the rooms in zero weather. From the description given, it looks as though

the humidity would be high and as though the windows would be bathed in running water.

J. H. DAVIS: I would ask if the author tried putting the direct radiation under the windows near the floor and comparing that arrangement with placing it on the ceiling. According to the author's statement, he has in a room 26 ft. x 31 ft., with about 350 ft. of 1¼-in. pipe in the ceiling located about 4 ft. from the four walls. That must take care of the heat lost, because it is stated that the temperature of the incoming air was only about 70 deg. or 75 deg. F.

MR. BARRON: It seems to me that a simple hot blast system, with thermostatic regulation and humidity control, and with the ceiling coils eliminated, would probably produce as good results at less initial cost and with probably less cost of maintenance.

MR. ELLIS: I spent an afternoon recently in the building referred to by the author. I was smoking constantly. I noticed a remarkable difference in the rooms equipped with the system described as compared with those having only direct radiation. The air conditions in the rooms with the ceiling coils were much better. There was also a decidedly lower temperature around the windows in the rooms having direct radiation beneath them. There was hardly any appreciable difference in temperature in any part of the room that had these coils around the ceiling. Apparently it was as warm in front of the windows as in other parts of the room. In the rooms equipped only with direct radiation, the smoke from my cigar would hang in the corners and at other points.

MR. WHITTEN: In confirmation of what Mr. Ellis has said, in many tests for air currents in school rooms, I have found that with the radiators placed underneath the windows, there is a rising body of warm air from the radiator, which means a corresponding falling body of air from the window, and there is a conflict set up there at once. The warm air from the radiator is deflected into the room, so there is a revolving action in front of the window caused by the warm air meeting the cold air. When the radiation is moved away from the window or removed altogether and the warm air supplied from above, there is a constant fall of air in front of the window. The colder the weather and the colder the window, provided it is tight, the more rapid the downward flow.

MR. SNOW: I would like to ask if the tendency of the ventilating duct placed in the exposed corners of the room is not to draw out a considerable qantity of the fresh air which has just fallen, by coming into contact with the chilling walls and the floors, and drawing that air out before it has really penetrated into the seating spaces. Also, does not the placing of coils on the ceiling tend to cause a recirculation, as in mill heating, and thus act to strip that air from the heating spaces?

MR. BEERY: The humidifier used in this installation was a simple iron water pan, containing a submerged pipe with a series of petcocks along it. We used low pressure steam to heat the water, the steam valve being under thermostatic control. This arrangement permitted the passing air to take up a certain amount of saturated steam with it.

Referring to the desirability of a ceiling outlet, I would say that it is not necessary. With the system in question, there is none. A ceiling outlet, with the system described, would never be open during the time that the room was occupied for school purposes. If it were necessary to fumigate a school room, with, say, formaldehyde, the smoke would spread to all parts of the room and if outlets were open at the top and bottom and the fan put in operation, it would be possible to quickly get rid of the odors.

There is a decided advantage in placing the heating coils on the ceiling. The advantage is that we are reducing our temperatures at the ceiling. The ceiling coils are not intended to be used for heating the room, but for preventing too high temperatures up there, which are unnecessary. With outside temperatures ranging around 45° to 50° F., we do not need to use ceiling radiation, as we do not need to prevent high final temperatures in the ventilating air. When the temperature gets down to 30° and lower, the radiation on the ceiling is a decided advantage and the benefit is correspondingly increased as the outside temperature continues to go lower or remain low.

Regarding the by-passing of the incoming air to the vent flues, we took a low pressure steam line and admitted steam to the room until it was completely filled. When that steam blanket got to a low level there was no more reason why it should not go over to the vent flues at the four corners than that the air should do so. But you could not find any place in the room where the density was not uniform. There was absolutely no lateral movement until you got down considerably below the desk tops.

With the method under discussion, there is a uniform volume of air moving downward through the breathing zone much like the operation of moving picture films. It is an endless movement of air passing straight through the occupied part of the room, as compared with a varying series of spiral glides of air currents, as the main volume settles to the floor in general practice. Radiation on the floor, at any points in the room, tend to aggravate the air currents to further increase their spiral movements. This has the effect

of preventing a uniform volume from spreading over the entire floor area in its movement toward the floor and thence towards the exits.

Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

CONDENSING PLANTS.

Condensing Plants for Large Commercial Buildings. Ira N. Evans. Explains the system which can be applied to any height of building. 1500 w. Power—Jan. 21, 1913. 20c.

DISTRICT HEATING.

District Heating System of Evansville, Indiana. Public Service Company. H. A. Woodworth. Describes details of a large installation. 6800 w. Nat. Eng.—Dec., 1912. 20c.

HEATING SYSTEM.

The Hot-Panel and Hot-Floor Border System of Heating. H. Riall Sankey. Read before the Jr. Inst. of Engrs. Describes an application of this system. Ills. 3300 w. Engng.—Jan. 17, 1913. 40c.

SCHOOLS.

Plumbing, Heating and Ventilating in the Albany High School. H. L. Alt. Illustrated detailed description. 5000 w. Dom. Eng.—Dec. 28, 1912. 20c.

Sheet Metal Duct Work in Waco High School. Illustrates and describes structural details and design of fan connections, warm air and ventilating ducts. 2000 w. Met. Work.—Jan. 3, 1913. 20c.

VENTILATION.

High Standard for Gymnasium Ventilation. Illustrated description of ventilation equipment designed to reproduce the freshness of out-door air conditions. 3500 w. Met. Work. —Jan. 17, 1913. 20c.

WIND VELOCITY.

The Electrical Measurement of Wind Velocity. J. T. Morris, Engng.—Dec. 27, 1912. 5700 w. 40c.

Suggestions for Uniform Ventilation Law.

The discussion of a proposed model ventilation law at the recent annual meeting of The American Society of Heating and Ventilating Engineers made it very clear that such a law must be general in its terms, as the details would always be affected more or less by local conditions. Such details could more readily be taken up as the occasion arose. The uniformity would lie in a common basis for the fundamental requirements.

As showing the difficulties met with in elaborating on the specifications, it was brought out in connection with the temperatures in sick rooms, for instance, which as specified in a tentative bill, were to be between 65 degrees and 70 degrees F., that in some cases 70 degrees is hardly considered sufficient. Another proposed requirement that the variation of temperature in different parts of a room should not be more than 5 degrees F. brought out the comment that if this limit were to apply as between the ceiling and floor, it could not be fulfilled. It was suggested that such a requirement specify the breathing line.

Another speaker suggested any horizontal plane, as he said the breathing line is rather indefinite, being at a height of 3 feet for a child and perhaps 6 feet for an adult. Another speaker thought the matter of sick room temperatures should be omitted entirely from a compulsory ventilation law.

Again, a specification regarding the use of air washers, it was pointed out, would not always be practicable, for in some localities school and similar buildings are without sufficient water supply.

Regarding maintaining a relative humidity of from 50 per cent. to 70 per cent., this was shown to be difficult of accomplishment in cold weather, unless double sash were used. It was suggested that this should be varied with the outdoor temperature.

Another point raised was that if care were not used to provide against it, the requirements might very easily be made to apply to the home.

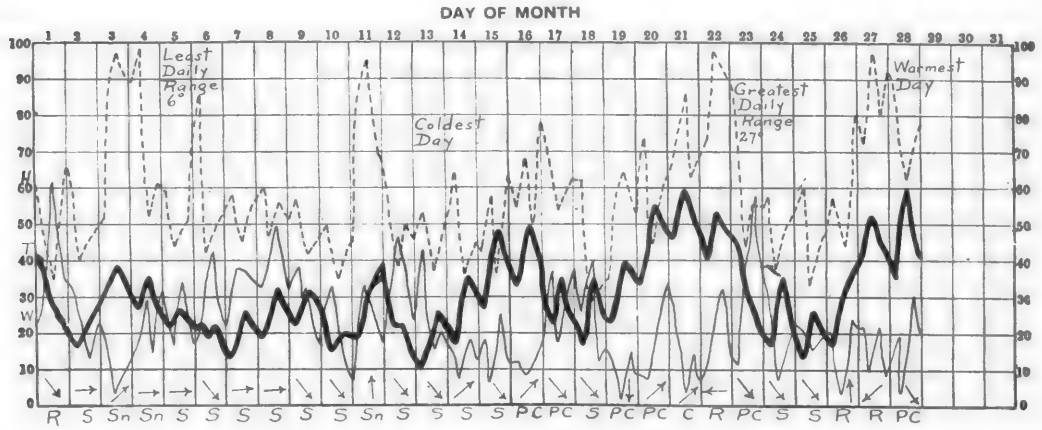
Heating By Electricity in Seattle.

The municipal lighting plant in Seattle, Wash., has been able to supply electric current at such a low cost, due to its splendid water power at Cedar Lake, that the authorities are seriously considering the furnishing of electricity for the heating of buildings. The City Lighting Department, under the direction of Supt. J. D. Ross, is now operating several test installations where the houses are heated and all cooking and heating of water is done electrically. A number of questions in this connection have still to be solved, such as thermal insulation, off peak and on peak loads, before the practicability of the scheme can be determined.

If the scheme proves feasible, the lighting department will propose the construction of a large hydraulic plant, especially for heating service.

The Weather for February, 1913

	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F.....	60	60	62	62	69
Date of highest temperature.....	28	20	20	19	18
Lowest temperature, degrees F.....	10	3	3	–2	4
Date of lowest temperature.....	13	10	6	5	1
Greatest daily range, degrees F.....	27	37	26	26	27
Date of greatest daily range.....	23	1	22	14	18
Least daily range, degrees F.....	6	8	3	6	6
Date of least daily range.....	5	22	28	26	28
Mean temp. for month, degrees F...	31	28	29	24.8	32
Normal mean temp, for month, deg. F.	30.7	28	32	25.4	33.5
Total rainfall, inches.....	2.18	2.99	2.11	1.97	1.2
Total snowfall, inches.....	2.4	7.7	8.7	5.5	7.6
Normal precipitation, this month, in.	3.74	3.44	2.66	2.16	2.75
Total wind movement, miles.....	13,430	7,753	9,049	9,792	7,586
Average hourly wind velocity.....	20	11.5	13.5	14.6	11
Prevailing direction of wind.....	N.W.	West	West	West	S.E.
Number of clear days.....	13	16	9	10	12
Number of partly cloudy days.....	10	4	8	9	4
Number of cloudy days.....	5	8	11	9	12
Number of days on which rain fell...	8	7	13	6	11
Number of days on which snow fell.	4	4	10	6	7
Snow on ground at end of month, in..	None	None	Trace	4.2	1.4


DAY OF MONTH
Least Daily Range 6°
Coldest Day
Greatest Daily Range 27°
Warmest Day
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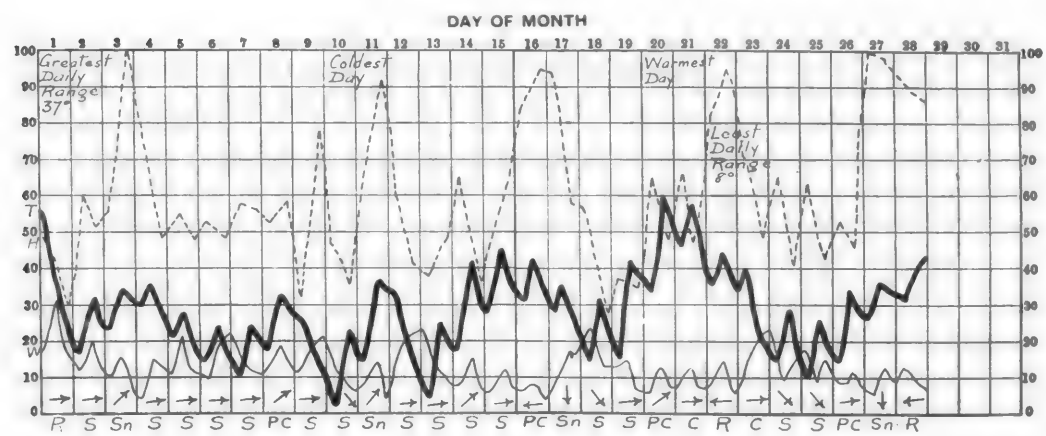
RECORD OF THE WEATHER IN NEW YORK FOR FEBRUARY, 1913.
(Hourly Observations of the Relative Humidity are Recorded on This Chart.)


DAY OF MONTH
Greatest Daily Range 37°
Coldest Day
Warmest Day
Least Daily Range 8°
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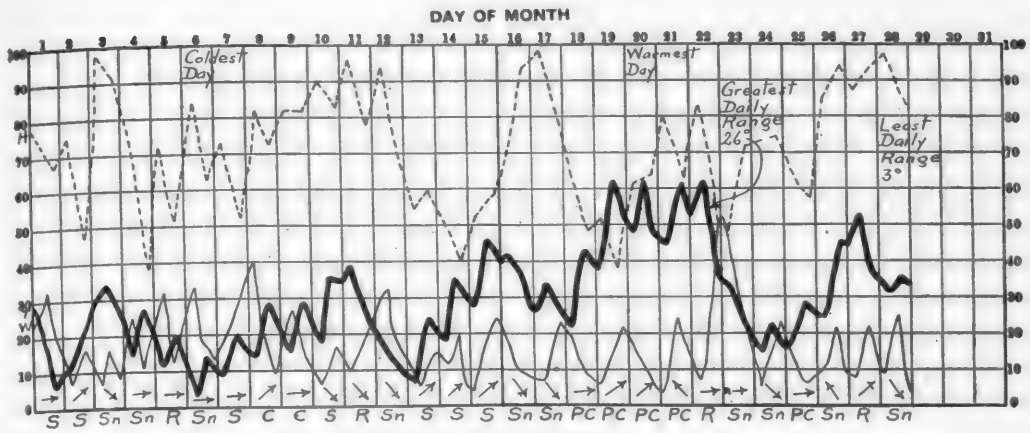
RECORD OF THE WEATHER IN BOSTON FOR FEBRUARY, 1913.


DAY OF MONTH
Coldest Day
Warmest Day
Greatest Daily Range 26°
Least Daily Range 3°
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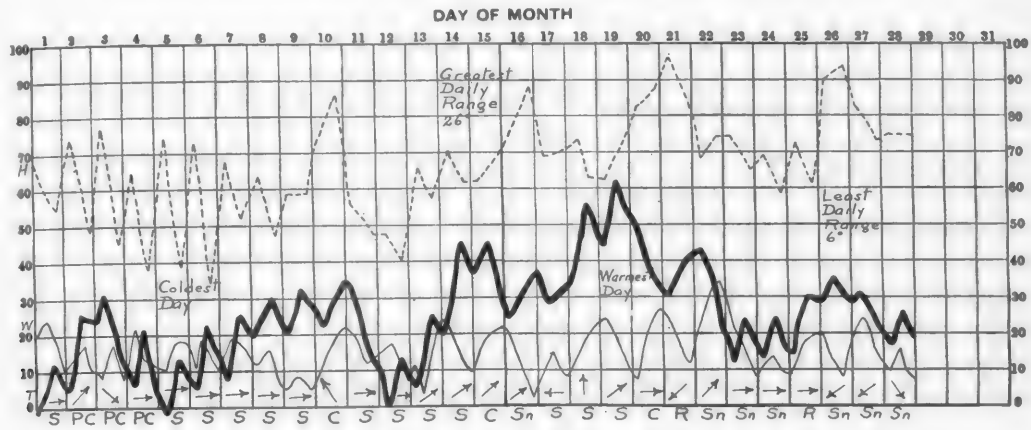
RECORD OF THE WEATHER IN PITTSBURG FOR FEBRUARY, 1913.


DAY OF MONTH
Greatest Daily Range 26
Least Daily Range 6°
Coldest Day
Warmest Day
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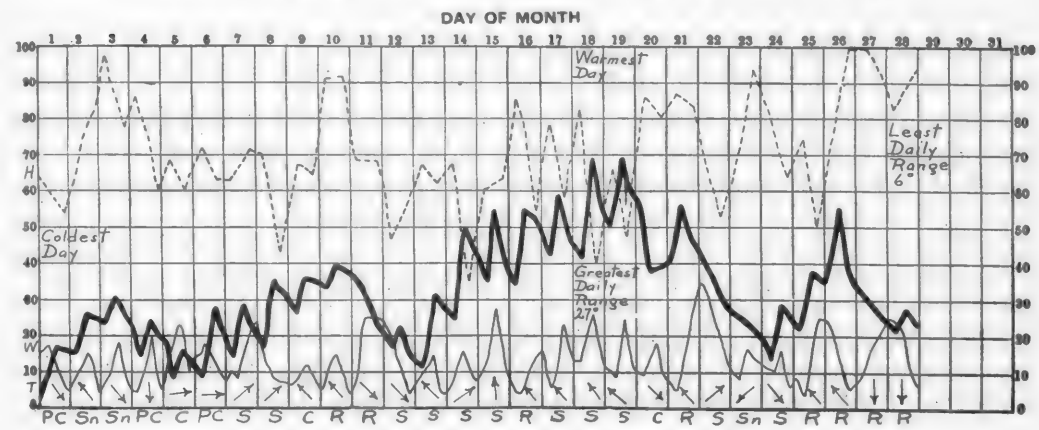
RECORD OF THE WEATHER IN CHICAGO FOR FEBRUARY, 1913.


DAY OF MONTH
Warmest Day
Least Daily Range 6°
Coldest Day
Greatest Daily Range 27°
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RECORD OF THE WEATHER IN ST. LOUIS FOR FEBRUARY, 1913.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter Discusses Removal of Steam from Dye Houses.

The practical problems involved in the removal of steam by mechanical means from dye houses, together with a description of the heating and ventilating features of the New York General Post Office, were presented at the March meeting of the New York Chapter by Claude A. Bulkeley, formerly chief engineer for the St. Louis Department of Education, and now associated with Marks and Woodwell, engineers for the new postoffice.

Mr. Bulkeley stated that where no special provision has been made for the removal of the steam given off by the various dye tubs, the accumulation of moisture and fog in dye houses often becomes very objectionable, dependent largely upon weather conditions. The worst conditions usually exist on a rainy day with an outside temperature between 40° and 50° F. Under these conditions of weather, the atmosphere in a dye house often becomes so heavily laden with moisture and fog that objects and men are only discernible for a distance of 3 to 4 ft. Such a condition renders effective superintendence of the work impossible, causes condensation to gather on the roofs, which in time rots out the roof construction and produces a drip from overhead which is likely to damage goods dyed in delicate tints.

The most aggravated conditions exist in dye houses where piece dyeing is done extensively. In this class of work large tubs, about 6 ft. by 8 ft., are kept filled with boiling water and the goods are rotated over reels placed about 3 ft. above the surface of the water in the tubs. Nearly all the heat of the steam required to keep these tubs boiling is utilized in converting the water in the tubs into steam, which is discharged directly into the atmosphere. In large dye houses, the total quantity of steam so discharged into the air is often the equivalent of several hundred boiler horse power.

HOT BLAST UPWARD VENTILATION FAVORED.

The most effectual and successful method for the removal of steam from dye houses in which conditions are bad is by the hot blast upward-ventilation method. Warm air should be furnished and properly distributed by means of ducts. A portion of this air should be delivered in a horizontal direction under the roof and the remainder discharged near the floor, thus tending to drive the moisture upward and at the same time absorbing it. Suitable means must also be provided for removing the moisture-laden air near the roof line. This can be accomplished by roof ventilators mounted at the top of the ventilating stacks, built of wood and properly insulated.

There are so many variables to be taken into consideration in designing hot blast, steam removal equipment that, unless careful consideration is given to each particular case, satisfactory results may not be secured. It is essential before designing an equipment to know approximately the number of pounds of steam per hour which must be removed and then compute the quantity of air which must be provided at the correct temperature to absorb this quantity of steam.

Methods of operation in dye houses are so varied that it is difficult to determine what proportion of the total weight of steam utilized in the dye house must actually be removed by the steam removing apparatus. If a large proportion of the steam supplied is utilized to heat cold water to a moderate temperature of, say, 150° F., very little discharge of steam to the atmosphere will result. If, however, a large proportion of the steam supplied is utilized in keeping the water in the dye kettles boiling, practically all of the steam so furnished is finally discharged into the atmosphere and must be removed.

Practice has shown that in order to properly remove the steam from dye houses, it is necessary to provide sufficient fresh warm air to give a complete change of air in the dye house every 3 to 10 minutes, according to the conditions to be met.

Mr. Bulkeley illustrated his remarks by showing a lantern slide giving the layout of a steam removal equipment recently installed in the dye house of a large New England textile mill. In this particular instance, a fan was provided to furnish 54,000 cu. ft. of air per minute and the layout was made so that the capacity can be doubled at any time by the installation of an additional fan and the extension of the duct work.

Mr. Bulkeley's remarks were illustrated by lantern slides, including a plan of a typical dye house installation and numerous views of the postoffice building equipment (described in THE HEATING AND VENTILATING MAGAZINE for March, 1913).

DATA WANTED ON TESTS OF HEATING AND VENTILATING APPLIANCES.

For the Committee on Tests, Chairman James A. Donnelly presented a resolution, which was unanimously adopted, as follows:

Resolved, That the Committee on Tests recommends that the New York Chapter of the American Society of Heating and Ventilating Engineers, through the trade

press, invites all manufacturers of heating and ventilating appliances as well as all engineers, technical institutions, etc., to submit data covering any tests of heating and ventilating apparatus, and appliances that they may have made, for compilation and submission to the society. Full details concerning all tests and the conditions under which they were made should be included.

Communications should be addressed to "The Committee on Tests, New York Chapter of A. S. H. & V. E., 29 West 39th St., New York."

Announcement was made that the Yale University Student Branch of The American Society of Mechanical Engineers will hold a meeting at New Haven, Conn., April 16, to discuss factory heating, in the afternoon, and factory lighting, in the evening. Members of the New York and Boston Chapters were invited to attend this meeting which will be held at the Mason Laboratory Yale University.

It was also announced that through the courtesy of W. T. Fanning, architect for the Paterson (N. J.) Board of Education, the opportunity had been presented to several heating engineers to inspect a school building at Prospect Park, N. J., which is equipped with automatic ventilating devices. The results of the inspection will be presented at the New York Chapter's April meeting.

The deaths were reported of Dr. John S. Billings, formerly director of the New York Public Library, and of John A. Payne, of Jersey City. Dr. Billings was an honorary member and Mr. Payne a charter member of The American Society of Heating and Ventilating Engineers.

Massachusetts Chapter Favors Proposed Ventilation Standards for Picture Theatres.

The Massachusetts Chapter, at its March meeting, held March 11 at Louis' Cafe, adopted recommendations for minimum ventilation standards for moving picture shows. The recommendations favored were those contained in the report of the Committee on Ventilation Standards for Motion Picture Theatres, made to the society at its annual meeting and printed on another page of this issue.

The principal speaker of the evening was Frank T. Chapman, chairman of the committee having this matter in charge, who discussed the questions that came up in formulating the report and why the various standards were decided on.

Those who took part in the discussion were Capt. Joseph A. Moore, Chares F. Eveleth, President Frank Irving Cooper, J. W. H. Myrick, A. B. Franklin and Charles Kimball. The speakers were unanimously of the opinion that such legislalation is most important for the protection of the health of the people, as at least 75,000 persons attend picture shows in Boston daily. At present there is no law in Massachusetts governing this matter which attempts to set up any standards. It was brought out that the motion picture shows in Boston, as a rule, occupy larger quarters than the same class of houses in New York.

Among the guests present in addition to those mentioned, were: T. F. McCoy, M. A. Dame, of Lynn, J. M. Greenlaw, of Beverly, and A. B. Franklin, Jr., of Boston. President Frank Irving Cooper presided.

Ventilation Experiments at Chicago Normal School.

A description of the progress being made in connection with the unique ventilation tests at the Chicago Normal School building were reported at the March meeting of the Illinois Chapter. These tests, it will be remembered, are being made in a special experimental room where the fresh air is brought in through a false floor and drawn out through openings in a false ceiling.

F. W. Shepherd was the chief speaker of the evening. He told of the keen interest that had been taken in the experimental work by prominent heating and ventilating engineers. He stated that he was a resident member of the Normal College, and that everything done in the experimental room was under the supervision of the Chicago Ventilation Commission.

Referring to the quantity of air injected into the room through the 3-in. openings distributed over the floor, it was found that this system furnished sufficient air but did not distribute it properly.

Another difficulty was in combating the window chill. The room contains three windows, one facing north and the others south and west, respectively. The north window is warmed by a steam pipe 3 in. in diameter, the west window with a 4-in. pipe and the south window was unprovided for. It was found that none of the arrangements was successful in breaking up the window chill.

Mr. Shepherd showed a number of charts giving temperature observations taken in the room during February, 1912. These temperatures were taken from three ther-

mometers placed on a vertical support. The first thermometer was located 6 in. below the false ceiling, the second about the height of the breathing zone of the children when standing, and the third 6 in. from the floor.

The following table shows the direction of the wind, the outside temperature, and the readings of the thermometers in their relative positions:

	E.	W.N.W.	N.N.W.	N.W.
Direction of wind.....				
Outside temperature, degrees F.....	36	28	17	13
Inside temperature, degrees F.....	65-63	63-61	65-64	62-61
Inside temperature, degrees F.....	67-63.5	65-61	70-62	63-59
Inside temperature, degrees F.....	63-63	57-55	61-55	56-54

The speaker also showed a "comfort zone" chart, which contained the records of 150 readings that had been taken in the experimental room. The comfort zone was found to correspond to a temperature between 63° and 65° F. and a relative humidity of 56%. It was also found that the zone still remained comfortable when the temperature went higher and the relative humidity lower.

Mr. Shepherd stated that a scheme for dividing the air supply is now under serious consideration. An arrangement is being tried whereby the air forced into the room for heating purposes will not be breathed. It is proposed to have a sheet of hot air all around the room, and, by this means, the pupils' lower extremities will be carefully warmed. This is also designed to eliminate the window chill. Architects and heating and ventilating experts have declared the scheme to be practicable.

"The central truth in ventilation," declared Mr. Shepherd, "is the fact that currents and disturbances are very easily produced in atmospheric air. This fact becomes oraçular, inasmuch as it explains equally well why good ventilation is both easy of accomplishment and difficult to obtain."

Mr. Shepherd was given a rising vote of thanks for his address which was discussed by many present. The committee in charge of the meeting was composed of J. H. Kassa, chairman; H. W. Ellis, and George H. Kirk.

The April meeting, to be held April 14, at Vogelsang's Restaurant, Chicago, will be devoted to a discussion of the heating and ventilating of large manufacturing plants.

Opposition to Massachusetts Chapter's Bill for Separation of Contracts.

Opposition to the bill of the Massachusetts Chapter providing for separate heating and ventilating contracts in public work, developed at a hearing before the Committee on Municipal Finance in Boston. The bill is drawn to read that on making contracts involving an aggregate expenditure of more than $1,000, cities, towns and counties shall make separate contracts for (1) plumbing, (2) steam and hot water heating, ventilating apparatus and power plants and (3) electrical installation, including electric generating plants.

The bill was favored by A. B. Franklin, David Craig, John E. Chatman and Alfred J. Hixon. Emphasis was laid on the fact that under the present system of letting blanket contracts, the fortunate contractor lets much of the work to sub-contractors, and that some of them, who are unscrupulous, do not hesitate, after securing a bid from one sub-contractor, to use the bid as a club to force down the price fixed by some other bidder.

Corporation Counsel Joseph J. Corbett, representing the city of Boston, opposed the bill. "If it is good legislation," he said, "there is no reason why it should be confined to three trades, but it should be extended to all. The logical result of such legislation is to deprive municipalities and counties of the ability they have at present of placing their finger upon some single individual, and holding him responsible for inferior work, delays, etc. It also tends toward the greatest evil municipalities have to contend with—the split contract—and consequent awarding of contracts as political favors.

John A. Sullivan, chairman of the Finance Commission, also opposed the bill on similar grounds.

Michigan Master Steam Fitters Organize.

The organization of a State association of master steam and hot water fitters in Michigan was effected March 18, at the annual meeting of the Michigan Master Plumbers' Association in Saginaw. The intention on the part of those interested to form a master fitters' organization was announced at the close of the first session. At a preliminary meeting, G. W. Harrington, of Detroit, acted as temporary chairman, and Charles Cannon, of Saginaw, as secretary. It was explained that the movement originated with a number of Detroit contractors, and on motion the meeting voted unanimously to organize as a master fitters association. A nominating committee was appointed, consisting of Messrs.

Partlan, Detroit; McGurrin, Grand Rapids; Pulte, Grand Rapids; Wurm, Detroit, and McCullom, Muskegon. This committee nominated the following ticket which was unanimously elected: President, George McCullom, Muskegon; vice-president, Charles Licht, Detroit; secretary and treasurer, Otto Wurm, Detroit; executive committee: the above-named officers and G. W. Harrington, Detroit.

The new organization will affiliate with the National Association of Master Steam and Hot Water Fitters, provision being made for admitting the present members of the National association in Michigan.

Master Steam and Hot Water Fitters of Newark (N. J.) and Vicinity elected the following officers at its annual meeting, March 18: President, Walter A. Lawson; vice-president, John G. Kellar; treasurer, Wm. M. Whitlock; secretary, Harry Geiser; member of executive committee, Robert Berla. Thomas G. Badgley was appointed sergeant-at-arms. Delegates to the annual convention of the National association will be chosen at the May meeting.

National District Heating Association.

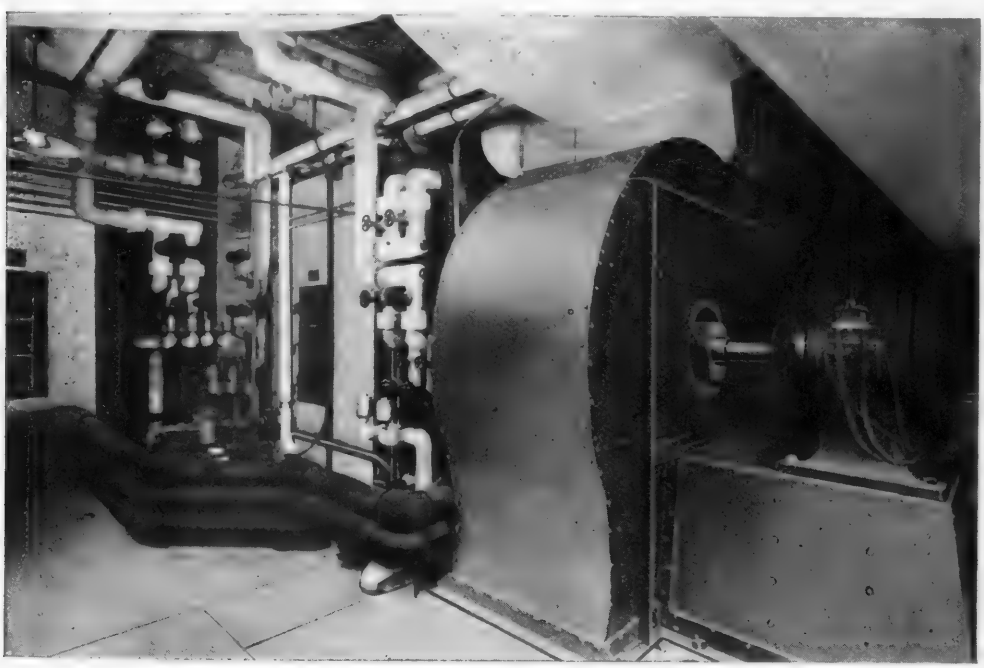
An important attraction in connection with the coming convention of the National District Heating Association, in Indianapolis, Ind., May 27-29, 1913, will be the international 500-mile automobile race on the Indianapolis Motor Speedway. This race will be held on the day following the close of the convention, and the entertainment committee of the association is advising members to make reservations for seats before April 15. The committee also calls attention to the importance of making hotel reservations promptly owing to the crowds which will be in Indianapolis at about the time of the convention. Reservations for both hotel and for the Speedway races may be made through J. L. Patrick, secretary of the N. D. H. A. Entertainment Committee, Indianapolis branch, Armstrong Cork Co., Indianapolis.

Fan Equipment for the McAlpin Hotel, New York.

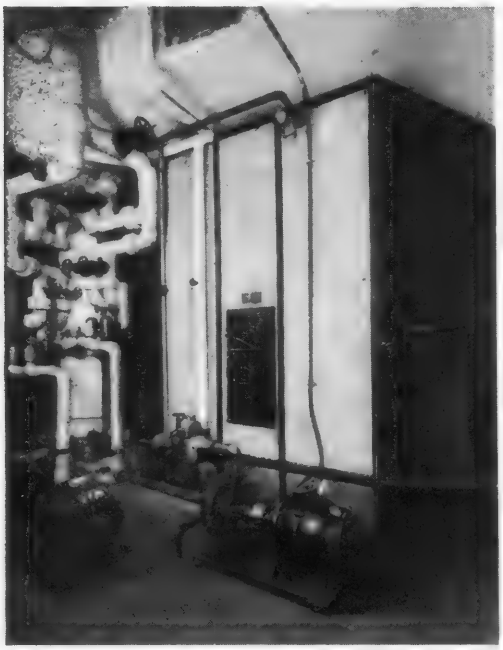
The extent to which mechanical ventilation is being applied in modern hotel buildings is illustrated in the equipment for the McAlpin Hotel, at Broadway and 34th St., New York, where no less than 7,800,000 cu. ft. of fresh air per hour is supplied to certain parts of the structure and 13,300,000 cu. ft. is exhausted. Moreover, all of the air supply is conditioned by being passed through Carrier air washers.

In order to render the installation entirely flexible, the mechanical ventilating system is divided into fifteen units, as follows:

1. Supply and vent units for the entire second sub-basement.
2. Supply and vent units for the entire first sub-basement.
3. Supply and vent units for the kitchen,



ONE OF THE FAN AND HEATER UNITS, McALPIN HOTEL, NEW YORK.



AIR WASHER IN CONNECTION WITH FAN UNIT NO. 4, McALPIN HOTEL.

barber shop, manicure, steward, toilets, and second floor serving room.

4. Supply and vent unit for the main lobby, lounging room and men's café.

5. Supply and vent unit for the banquet hall, ladies' café, main dining room, and rathskeller.

6. Vent unit for the ball room, smoking room, ladies' retiring room, and ball room corridor.

A separate system of vent ducts, with dampers and registers, are furnished for the interior baths. This system is divided into three zones, each zone being handled by its respective vent fan. There is also a separate unit for the ventilation of the Turkish bath room.

VENT UNIT NO. 6, McALPIN HOTEL.

One of the features of the installation is the apparatus for cooling the air supplied to the rathskeller. This comprises an air washer supplied with iced water from a Boudelot cooler. As operated, the air washer is of sufficient capacity to deliver air to the rathskeller at a uniform temperature of 70° F., irrespective of the outdoor temperature. As a rule, the vent registers in this installation are located near the floor. An exception is made in rooms where the removal of smoke is desirable. There the vents are placed near the ceiling for quickly removing all smoke and fumes.

All of the blowers are steel plate fans of the Buffalo Forge Company manufacture, and were furnished through the company's New York office, Koithan & Pryor, managers. Each fan is driven by a direct-connected electric motor.

Arrangement of Thermostatic Regulation Apparatus in New York Post Office.

The New York General Post Office, at Eighth Avenue and 32nd, the heating and ventilation of which were described in last month's issue, is equipped with a system of thermostatic control that, in some respects, is rather unusual. The regulation is operated first by the temperature of the air passing through the primary, secondary and tertiary heaters and by the heating surface between the upper and lower glazing of the court skylight.

The various primary and secondary heaters are controlled by thermostats of the duct type, with thermostatic stems exposed within the air ways. Thermostats in each of the fresh air intakes are connected with the outer sections of the related primary heaters operating their respective valves when the temperature of the incoming air falls to 20° F., and thermostats in each of the air-ways on the delivery side of the fans are connected with the secondary heaters, operating their respective valves when the temperature of the outgoing air is 70° F.

The temperature of the court enclosure, foyer and skylight monitor is controlled by thermostats of the room type, operating valves on the tertiary heaters and pipe coils. These thermostats maintain a temperature of 65° F., with the exception of the court skylight thermostats, which operate at 35° F.

A blue Vermont marble pneumatic switchboard, with twenty-seven nickel-plated switches and indicating plates, is located in the machinery room. These switches make it possible for the operating engineer to pneumatically operate every part of the vast heating and ventilating apparatus without leaving the machinery room.

The primary and secondary heaters are each divided into eight divisions, with sixteen pneumatic switches operating 64 diaphragm valves.

This scheme affords a very economical and accurate operation of the plant, as it is possible to cut out the surplus radiation in mild weather, thereby preventing any overheating after the thermostat has shut off the steam supply valves, and permitting steam to enter no more than enough sections to raise the temperture to its required point.

The fresh air intake dampers, the main uptake dampers and the discharge dampers from the several fans are each independently controlled by pneumatic switches. The steam valves on the east foyer heater are controlled in three groups by switches, and the several fan heaters and hot water generators are independently controlled from the switch board.

The apparatus controlled by the switches is remarkable for its size, some of the dampers containing over 120 sq. ft. and weighing 195 lbs. Considering that the new post-office building extends over several city blocks, it will be appreciated that the thermostatic and pneumatic switch control system assures a simple, economical and accurate means of operating the heating and ventilating apparatus, impossible to obtain in any other manner.

The installation includes two electrically-driven air compressors, each capable of compressing 10 cu. ft. of air at 15 lbs. pressure per min., with a reservoir capacity of over 60 gals. Automatic governors are installed, making the compressed air generating apparatus automatic in every respect.

Over 20,000 ft. of galvanized iron pipe and 1,000 lbs. of fitting were used to make the connections between the thermostats and pneumatic switches, and to their respective valves and dampers.

The temperature control apparatus installed was that of the Standard Regulator Co., New York.

Requirements for Exhaust Systems Laid Down by New York State Department of Labor.

Specifications for the design, construction and operation of exhaust systems for grinding, polishing and buffing wheels, as required by Section 81 of the labor law, have been issued by the New York State Department of Labor, through the Bureau of Factory Inspection. The specifications have been drawn up after a careful study and tests ot such systems and are compulsory.

The minimum sizes of branch pipes allowed for different sized emery or other grinding wheels range from 3 in. for a 6-in. diameter wheel to 6 in. for a wheel from 25-in. to 30-in. diameter. This is followed by minimum sizes of branch pipes allowed for different sized buffing, polishing, or rag wheels, which must be ½-in. larger than those specified for emery wheels.

All branch pipes must enter the main suction duct at an angle not exceeding 45° and must incline in the direction of the air flow at junction with main. All bends, turns or elbows, whether in main or branch pipes, must be made with a radius in the throat at least equal to 1½ times the diameter of the pipe on which they are connected.

The inlet of the fan or exhauster must be at least 20% greater in area than the sum of the areas of all the branch pipes and such increase must be carried proportionately throughout the entire length of the main suction duct; that is, the area of the main at any point must be at least 20% greater than the combined areas of the branch pipes entering it between such point and the tail end or dead end of the system. If such increase is made greater than 20%, the area ot the main at any point, except that portion of it between the branch entering it nearest the fan and the fan, must bear approximately the same ratio to the combined area of the branches preceding that point (between it and the tail end of the system) as the area of the main at the branch nearest the fan bears to the combined areas of all the branches. This provision is made to permit the use or a fan having a larger inlet area than the area of the main at the branch pipe nearest to the fan, if desired.

Sufficient static suction head must be maintained in each branch pipe within one foot of the hood to produce the dfference of 2 in. of water between the two sides of a U-shaped tube.

All plans must be submitted to the department and the above test met before the system will be acceptable.

In addition to the requirements here mentioned, a list of recommendations is appended for the guidance of those designing such systems. A drawing is also added, showing an exhaust system laid out in conformity with the department's specifications for eight 14-in. emery wheels.

For the convenience of those wishing to use it, a table is given at the end of the pamphlet, showing what the size of the main suction duct should be at any point for any number of uniform-size branch pipes, when the main duct is made 20% greater than the combined areas of the branches entering it.

The specifications were prepared by William Newell, mechanical engineer for the Department of Labor and are issued from the Engineering Department, office of the Chief Factory Inspector, 381 Fourth Ave., New York, where copies of the pamphlet may be obtained.

Modern Vacuum Cleaning Apparatus

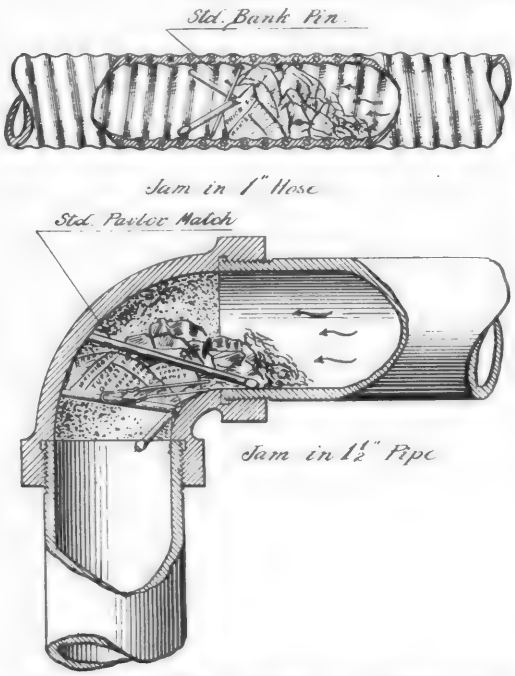
6—The Tuec Air Cleaning System.

In determining the essentials for an efficient vacuum cleaning apparatus, it is necessary to consider the different elements which make, in combination of motor, exhauster, separator, piping, hose and tools, that which is known as a vacuum or air cleaning system. The air cleaning system may be compared with a chain in that one weak link weakens the whole.

In the development of the Tuec air cleaning apparatus, the manufacturers have based their design on the following principles:

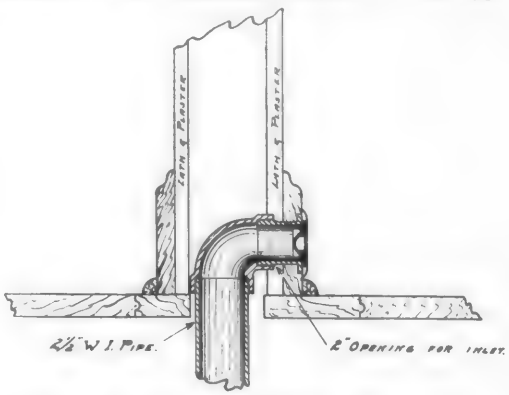
Starting with the motor, the point is made that if it be overloaded, or connected to the exhauster by gears, or by a complicated chain drive, or by a constantly stretching leather belt, or if it in any way necessitates expert care for its proper operation as a driving medium, it is not a perfect power device for a vacuum cleaner. As for the exhauster, it is maintained that if it be one of many closely-fitting parts necessitating constant and careful lubrication and adjustment, or if its capacity be such that it is incapable of exhausting sufficient air to insure proper removal of dust from many varied surfaces, it is not a perfect exhauster.

Proceeding to the dust separating device, the argument is advanced that if this be one of complicated parts, with small



HOW VACCUM CLEANING HOSE AND PIPING BECOME CLOGGED.

dirt capacity, necessitating frequent emptying, or if, by reason of its screens of filters, it be in constant danger of clogging up, or if, by offering such resistance to the free passage of air flowing from the cleaning tool to the exhauster, it necessitates the maintenance of too high a vacuum at the exhauster, with a consequent decrease in the exhauster's capacity and a large increase in the power consumption, or if, by reason of the resistance offered to the air



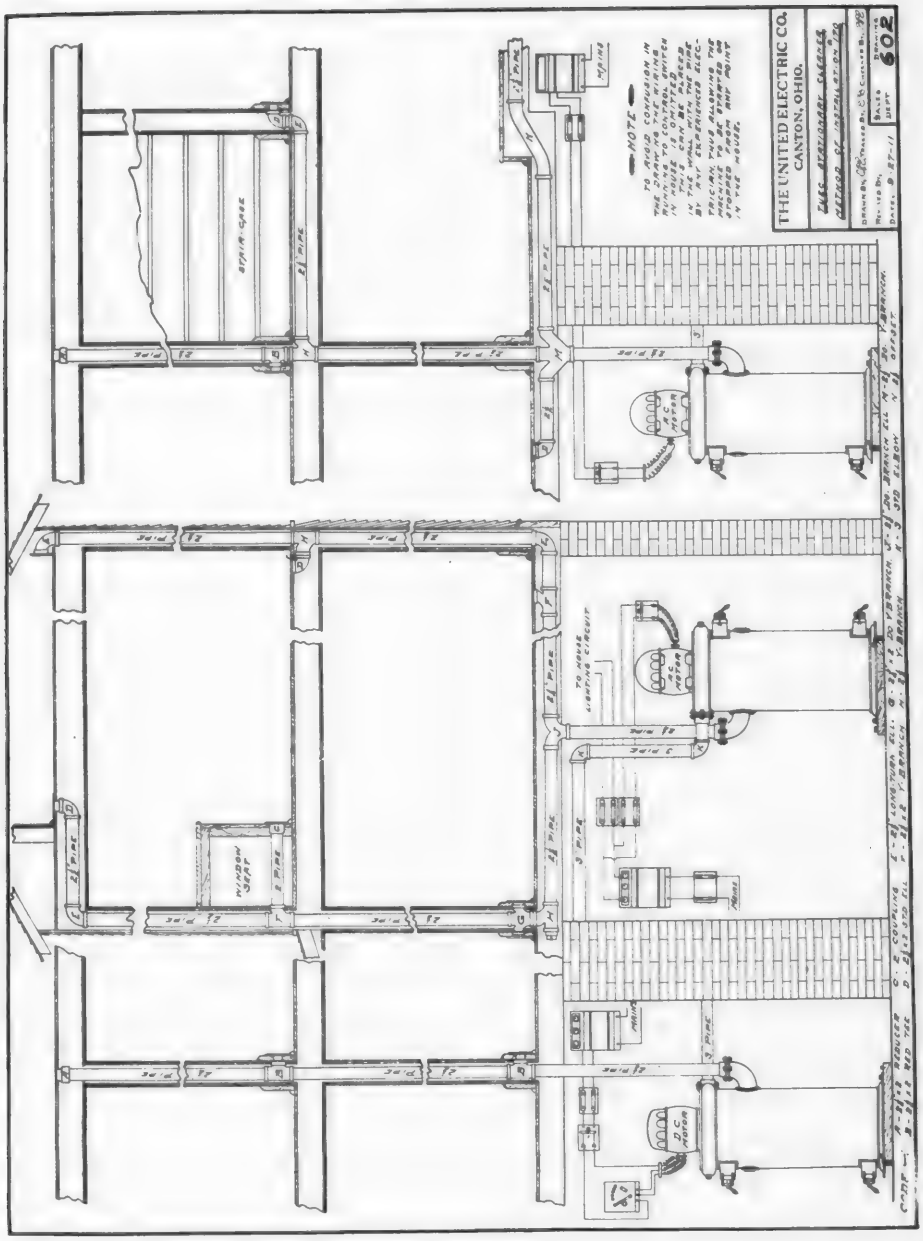
TUEC INLET INSTALLED. Scale: 3-4.

passing through it, it rarifies that air to such an extent as to reduce the cleaning efficiency of the system, then it, too, is a weak and imperfect link in the chain.

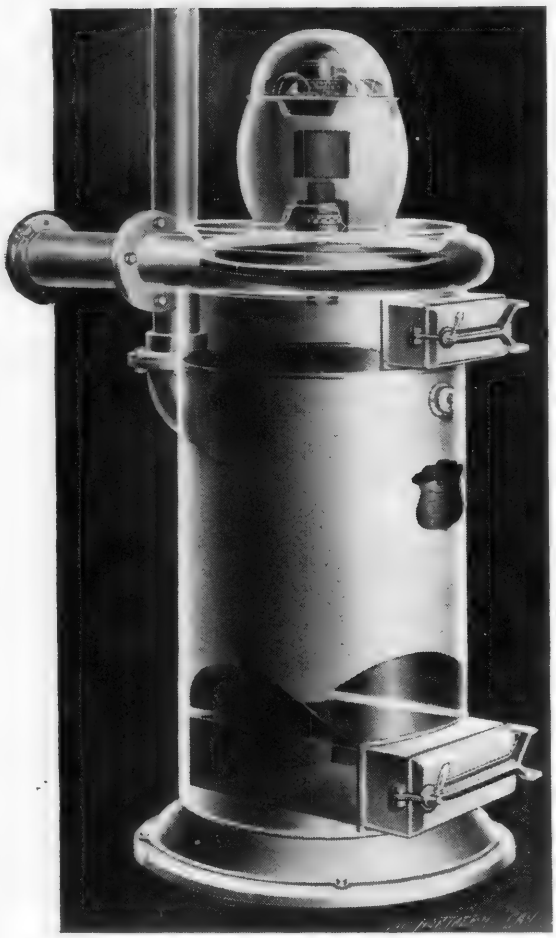
Next, to consider the piping, it is argued that if the piping should be laid out by one of little experience and knowledge, and proper care not be given to such details as the elimination of all pockets and "fins," or if its interior diameter be such as to cause excessive losses in air and vacuum by reason of "skin friction," or if it is so planned as to overload any portion of the piping or permit of its becoming clogged, or if its extent is so limited as to make the employment of long lengths of hose necessary for the cleaning of the farthermost points of the building, then it is another weak link of the chain.

As for the hose, it is further held that if this is of such small diameter as to offer excessive resistance to the flow of air, or if it is constantly in danger of being clogged by pins or other articles becoming wedged across its interior, or if it is not sufficiently flexible, or if it be of poor quality, or if its terminals and connections are complicated and likely to become wedged or locked, thus causing inconvenience in uncoupling and often strained wrists, then it is anything but a perfect part of the system.

Lastly, the point is made that if the tools for use on rugs or carpets are designed so


THE UNITED ELECTRIC CO.
CANTON, OHIO.
NOTE
TO AVOID CONFUSION IN THE CARE IN THE WIRING MINUTE TO CONTROL SWITCH THE SWEEPER CAN BE PLACED IN THE KITCHEN AND OPERATED BY ANY EXPERIENCED ELECTRICIAN, THUS ALLOWING THE SWEEPER TO BE USED AT ANY POINT IN THE HOUSE.
TO HOUSE LIGHTING CIRCUIT
SPACE
WINDOW SEAT

METHODS OF INSTALLING PIPING FOR ONE SWEEPER PLANTS. ALL OPENINGS FOR INLETS TO BE 2-IN.



PHANTOM VIEW OF TUEC MACHINE.

that the lips or edges of metal, which come in contact with the fabric being cleaned, are less than ⅜-in. across, thus making it absolutely sure that the fabrics will be subjected to undue wear, or if the tools are not light and flexible, or if they are not of sufficient variety and correct size and shape for the various surfaces to be cleaned, or if they are not substantially constructed or are too heavy for convenient and constant operation, then they, also, constitute a weak portion of the system.

The construction of the Tuec machine is described as being notably free from the faults or weak links here mentioned. Efforts have been made to make it as little complicated and with as few parts as possible and to make it durable and quiet in operation and at the same time to consume the minimum amount of power for the work done. With these features of design, emphasis is laid on the efficiency of the Tuec machines, upon the large volume of air they displace and upon their large dust capacity, and lower cost for maintenance. As the machine is entirely enclosed, it is found to be quite "fool" and accident proof.

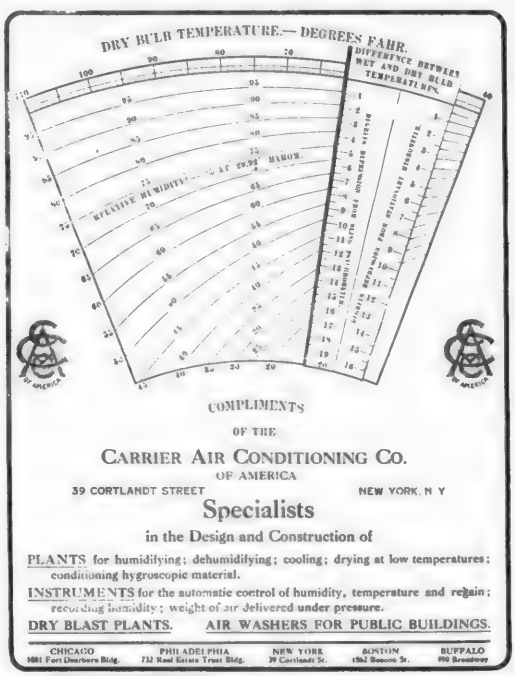
The makers call attention to the fact that all piping layouts used as a part of the Tuec system are designed by experts and care is taken to eliminate the faults found in ordinary vacuum piping. The Tuec hose is also notable as being light, strong and flexible and of sufficient size to insure the free passage of the air and dirt. Its tools are built for all varieties of cleaning work for which the air cleaner may be employed.

An interesting commentary on the success of the apparatus is in connection with the company's statement that the Tuec system is installed in 5,000 separate plants.

A Unique Hygrometric Chart.

An ingeniously-devised hygrometric chart by the use of which the relative humidity may be instantly ascertained for varying differences between the dry and wet bulb temperatures, has been prepared by the Carrier Air Conditioning Co., of America and is shown herewith.

The chart includes an index arm which may be swung either way across the face of the chart, the idea being to take the reading for relative humidity when the


DRY BULB TEMPERATURE.— DEGREES FAHR.
DIFFERENCE BETWEEN WET AND DRY BULB TEMPERATURES.
RELATIVE HUMIDITY
BAROM.
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OF AMERICA
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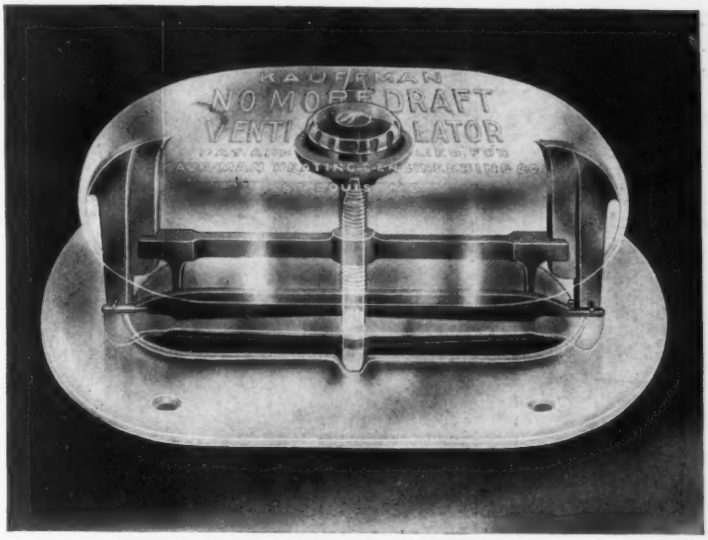
HYGROMETRIC HEAT FOR DETERMINING RELATIVE HUMIDITY WHEN DRY BULB AND WET BULB TEMPERATURES ARE KNOWN.

edge of the arm is on the known dry-bulb temperature line. The relative humidity may then be found opposite the wet bulb depression.

Two scales are shown on the index arm, one giving the depression as taken by a sling psychrometer and the other the depression according to a stationary hygrometer.

Copies of the chart ready for use, mounted on stiff cardboard and measuring 8x11 in. may be had by those interested by addressing the company at 39 Cortlandt St., New York.



KAUFFMAN MUSHROOM VENTILATOR.

An Improved Mushroom Ventilator.

A new style of mushroom ventilator, known as the Knowles notch vent cap, has lately been perfected by George E. Knowles, 69 Beekman St., New York, manufacturer of the well-known Knowles mushroom ventilators. The notch vent cap is a simplification of previous designs of these appliances which are for use in connection with the indirect or mechanical systems of heating and ventilating auditoriums.

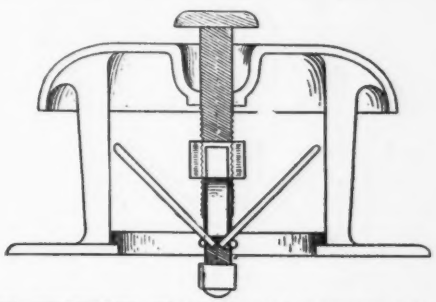
As will be seen from the accompanying

KNOWLES NOTCH VENT CAP.

illustration, the Knowles notch vent cap consists of but two parts, floor piece and hood. Three graduated notches permit the hood to be set at as many different-sized openings. A lock screw in the center controls the hood and not only renders it absolutely rigid, but effectually prevents its being tampered with. The Knowles notch vent cap is made in four sizes, including 4, 5, 6 and 8-in. diameter openings. Further information, including full-sized prints and prices, may be had from the manufacturer.

Kauffman Mushroom Ventilators.

The usefulness of the mushroom type of ventilator, designed to maintain an even distribution of air under the seats of theatres, schools, churches and other auditoriums where a mechanical heating and ventilating system is installed, is shown by the number of devices that are being placed on the market to meet the growing demand. One of the latest of these is the Kauffman mushroom ventilator, shown in the accompanying illustrations. This ventilator is made so that the dampers can be adjusted and set at any desired point, and the volume of air discharged from each one can be regulated, thus securing an even air distribution throughout the room. Through its use it is stated that duct dampers may be eliminated, as it gives control of the air current to a fraction of a cubic foot per minute. Hand control is provided, but, once set, the dampers may



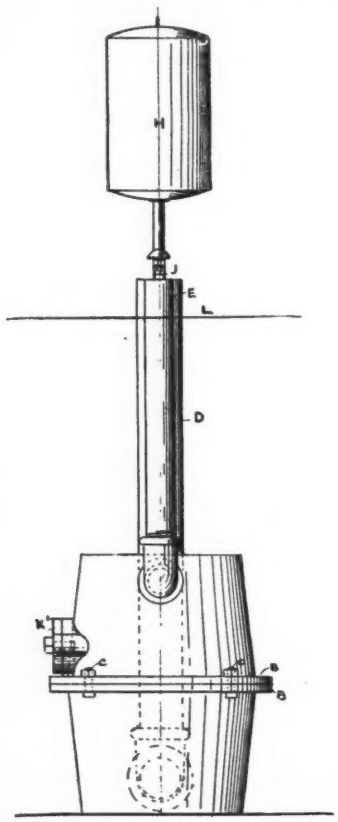
CROSS SECTION, KAUFFMAN MUSHROOM VENTILATOR.

be locked. These ventilators are made in three sizes: 4-in., 5-in. and 4-in. x 7 in. The list prices range from $1.50 for the smallest size to $2.25 for the largest size,

f. o. b. The manufacturer is the Kauffman Heating & Engineering Co., St. Louis, Mo.

A Device to Prevent Water Freezing in Tanks.

A submerged, cast-iron, kerosene tank heater, designed primarily to keep the water in outdoor tanks above the freezing point, has been designed by John Bernhard, of MacGregor, Ia., and is shown herewith.



SUBMERGED GAS WATER HEATER.

The heaters are now used principally to prevent the freezing of water troughs for cattle.

The device consists of a submerged cast-iron heater set on the bottom of the watering tank. The heater is fed with kerosene from a tank above the trough. The oil flows from this receptacle to the heater where it is changed to gas and burns as a gas flame. The flow of oil is regulated according to the weather.

A test of the device made last January showed that when the temperature fell to 37° F. below zero the water in the trough remained at 54° F. The heater will be manufactured and sold by Mr. Bernhard, at McGregor, Ia.

New Books.

CHLORIDE OF LIME IN SANITATION, by Albert H. Hooker, technical director of the Hooker Electrochemical Co., is a new book containing a very complete collection of data relating to this subject. The author states that an unexpectedly large amount of important information was obtained and the fact was clearly revealed that this inexpensive chemical is one of the most valuable and economical agents available for the protection, in many ways, of the public health. Each chapter deals with a different problem of sanitation, some of the more interesting being "The War Against the Infectious House Fly" and "Dust in Connection with Infantile Paralysis and Meningitis." Size 6x9 in. (standard). Pp. 231 Published by John Wiley & Son, New York. Price $3.00.

Trade Literature.

GORTON SELF-FEEDING BOILERS, made of wrought steel and designed for all systems of steam and hot water heating, are the subject of a unique catalogue published by the manufacturers, the Gorton & Lidgerwood Co., New York. Each part of the boiler is illustrated in views that show the construction in detail while the price lists give dimensions and capacities for each size heater, the capacities being backed up by the company's well-known guarantee, which is conditional only on the boiler being properly connected to a chimney flue having a good and sufficient draft, and that all cellar piping is well covered and the boiler is run according to the company's printed directions. The company's line includes steam and hot water boilers for use with hard coal as well as those for use with soft coal. The point is made that the soft coal boilers are so built that they will not produce black smoke. This is accomplished through the construction of the fire pot, allowing for sufficient air to be drawn through the fingered ring at the lower end of the coking chamber to ignite the gases arising from the coking process, thus giving complete combustion. Size 4x7 in. Pp. 24.

ELECTRICAL EQUIPMENT FOR BUILDINGS, including typical views of direct-connected ventilating motors, air compressor equipment, refrigerating machines and vacuum cleaner systems, is the subject of a handsomely-printed catalogue, issued by the Sprague Electric Works, New York. Size 8½x11 in. Pp. 24.

DRY KILNS FOR LUMBER PRODUCTS is a valuable treatise for engineers called upon to design equipment for this class of work. It is published by the American Blower Co., Detroit, Mich., and, besides giving an idea of the problems involved in the drying of lumber, contains much descriptive matter, with many typical installations, relating to the ABC moist

air dry kilns, designed for natural and for forced circulation and including progressive and apartment types. Size 7x9 in. Pp. 78.

BOOK OF STANDARDS, 1913 edition, published by the National Tube Co., Pittsburg, Pa., is a remarkable publication, having taken nearly four years in its preparation and representing much research and experimental work, in addition to the mass of data it contains on tubular goods and allied subjects. It is the first edition to be published since 1902, and its extent and comprehensiveness may be appreciated from the fact that it contains 559 pages, 4 x 6½ in., printed in fine type on Canterbury Bible paper. The book, however, including the binding, is not quite ⅝ in. thick. The information incorporated in this volume has made it strictly a pipe handbook, and as such it will undoubtedly have an immense use in the trade. The index is notably complete, all headings being cross-indexed. There are approximately 4,000 references found in the index. Included in the contents, a mere enumeration of which would occupy much space, is a descriptive article covering the main process of manufacturing both welded and seamless tubes; also giving information in regard to the threading, durability and physical properties, etc., of both "National" pipe and Shelby seamless steel tubes. The metric system is included, with conversion methods for most of the more commonly used measures, including temperatures. A glossary of terms used in pipe and fittings trade is published in the back of the book. Price, $2.00.

Hot Water Heating and Air Moistening.

The old theory that hot water heating adds moisture to the air is not such a fallacy as might be supposed, says Dr. W. A. Evans, writing in the "Chicago Tribune." "In hot water heating," he says, "the air comes in contact with coils that are 179 deg. F. and below. Fleugge demonstrated that when dust is heated to more than 160 deg. it becomes offensive. It is singed and distilled and there results some ammonia, some carbon monoxide and some other substances, less harmful, but more offensive. This cooked odor and feeling some people try to avoid by keeping the heating apparatus free from dust, while others adopt the less troublesome procedure of installing hot water heating."

Dr. Evans calls attention to the fact that with hot water heating, the air is not heated to such an extent as with steam and, therefore, the relative humidity is generally greater.

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